Minnesota State Medical Association Meeting, Minneapolis
October 12, 13, 14, 1922

VOLUME V NUMBER 8

MINNESOTA MEDICINE

Journal of the Minnesota State Medical Association

AUGUST, 1922

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Owned and Published Monthly by

THE MINNESOTA STATE MEDICAL ASSOCIATION

BUSINESS MANAGER
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Entered at the Post Office in Saint Paul as second class mail matter.
Accepted for mailing at the special rate of postage provided for in section 1103, act of October 3, 1917, authorized July 13, 1918.

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MINNESOTA MEDICINE

Journal of the Minnesota State Medical Association

VOL. V AUGUST, 1922 NO. 8

ORIGINAL ARTICLES

A GENERAL DISCUSSION OF FRACTURES BASED UPON MY PERSONAL EXPERIENCE*

W. H. MAGIE, M.D.
Duluth, Minn.

This paper is to be a short résumé of my experience extending over a period of thirty-seven years, in the diagnosis and treatment of fractures. I do not expect to completely cover the field of fractures and their treatment—it is too large a one to undertake in a paper of this kind—but merely to detail in a fragmentary way my experience. I will show by the lantern slides a few specimens of fractures of the different bones and at the same time I wish to lay particular stress upon the inability to diagnose many fractures without the aid of the *x*-ray; particularly is this true in fractures of small bones of the hands and feet. There can be no hard and fast rule to apply to the treatment of all fractures or even a limited class of fractures, such as the fracture of the long bones, namely, the femur, tibia, fibula, humerus, and bones of the forearm. Every fracture must be studied from its own individual standpoint. For instance, there is no hard and fast rule of treatment that we can apply to all fractures of one bone, such as the femur.

There are many varieties of fractures of the femur, namely, fracture of the head, fracture of the neck, both intracapsular and extracapsular, fracture of the shaft, transverse, oblique, longitudinal and spiral fractures and fractures of the condyles, etc. Each fracture is a problem that must be solved and treated in the manner that one's experience has taught him is the best. Opinions and practice based upon one's own experience are methods one will be most likely to adopt. Knowledge gained by experience is the most trustworthy and should be adhered to and will surely give the best results if you have the courage of your convictions and act accordingly, although at times it seems to conflict with opinions of others in high authority in the same line of work. We will take, as an example, a fracture of the neck of the femur; there are many methods employed in the treatment of this fracture. It does not matter what method we employ in getting the best possible union, results are of more importance than methods. I may not be able to obtain the same good results by a method that you employ as I would with a method that I have employed many times. Therefore, I should confine my treatment to methods that have proved most successful in my hands.

Probably the most common dressing for fractures of the femur has been a plaster of Paris cast. The use of plaster of Paris as a fixing and immobilizing dressing was introduced about forty years ago and still holds its position as a first choice dressing, with most surgeons, in fractures of the femur. This dressing has been a very satisfactory one in my experience. In the treatment of fractures of the lower end of the femur, I have found the Hodgen splint very satisfactory; as you know, this splint is a very simple one, in which the limb is elevated free from the bed after having first fixed the foot to the splint with a Buck's extension of adhesive. The leg is flexed upon the thigh. This position at once relieves the pull on the lower fragment, when it will automatically drop into place. The extension is kept up by a simple method of traction, made by the attachment of ropes passing from the splint over a pulley placed in the ceiling.

There are cases in which open operation will be necessary, in order that reduction may be accomplished. Then it will become necessary to choose one of several methods to fix the bones and hold them in position. For many years, I depended upon nails or wire for binding together the fragments. Silver wire was very satisfactory in many fractures that were oblique, spiral or longitudinal in character. Ivory pins or pegs were used often, but not always as satisfactory as nails or wire. Later on, the Lane plate was introduced and used with more or less success; it became, in fact, a real fad with the younger disciples of surgical art and was more often used unnecessarily than necessarily. Its popularity with the younger surgeons was undoubtedly due to its spectacular effect. The Lane

*Presented before the Minnesota Academy of Medicine, St. Paul, March 8, 1922.

Plate No. 1.—Unreduced fracture of femur four weeks after receipt of injury the sort that the use of a Lane plate is justified.

plate was not easily encapsulated on account of its size; it became, therefore, an irritant or foreign body, which nature tried to throw off eventually, making its removal, in many cases, necessary. A very frequent and unhappy result was failure, or a delayed union. This failure of union has been attributed to the perfect immobilization of the fragments. I do not agree with this explanation, for I am convinced that delayed or non-union is due to the great detachment of the soft parts from the bone in placing the plate directly upon the bone. The bone derives its nourishment, to a large degree, from the small blood vessels that pass from the soft parts through the periosteum into the bone. Therefore, when the soft parts are detached to a considerable extent, the bone is deprived of a large part of its nutrition, and this would naturally retard its union. I have often found delayed union in very badly displaced fractures of long bones that had been stripped of their soft parts by the trauma produced at the time of the accident. These were cases that made an open operation necessary, in order to obtain a reduction. Although these cases healed by primary union without infection, there was often delayed or non-union. I am convinced that there are a few cases of fractures of the femur in which a Lane plate, properly applied, offers the best chances of getting good union in the best possible position. In making the selection of the Lane plate, one should choose a smaller sized plate, as I believe that the less metal left in the wound, the better. In most of the cases, however, I have found screws made from stove bolts to answer the purpose very well, often with the help of silver wire wound around the bone, binding the fragments together. The stove bolts are screwed in at right angles to the shaft, usually passing through the bone, and cut off with a strong pair of nippers, flush with the bone. I first used nails for uniting fracture of the femur as far back as 1891. My first experience was in an old case of ununited fracture of the condyle of the femur. The internal condyle had been almost completely broken off. The fracture was a longitudinal one extending up about five inches, the fragment being held by a small base to the shaft of the femur. The condyle was very loose and could be moved around freely in the joint. The joint was widely opened by a horseshoe flap, exposing the fracture; curetting the fissure thoroughly, in order to leave good healthy bleeding bone, I drove an ordinary twenty-penny wire nail through the internal condyle, nailing it to the opposite one, or external condyle. The nail penetrated the external condyle, passing through one inch; then it was cut off flush with the bone and joint irrigated in a solution of mercury bichloride, and closed tightly without drainage. The healing was by first intention and the union of the fracture complete in about three months, and when discharged from treatment his joint was almost perfect, he being able to flex his leg on his thigh to a right angle. The result in this case was so satisfactory that I was encouraged to resort to nails quite often in fixing bones. Vary rarely have I found it necessary to remove nails or screws. They become encapsulated quite readily and cease to be an irritant. I have used aluminum bands in very

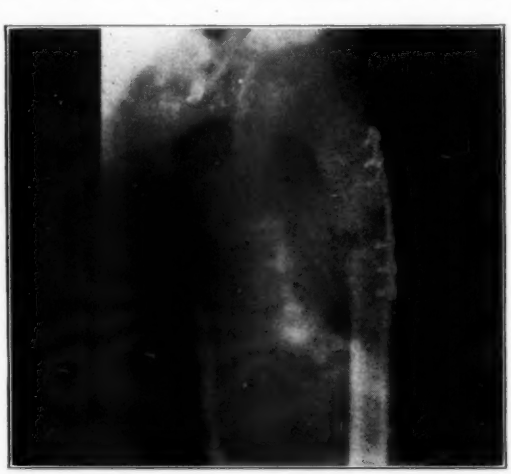


Plate No. 2.—Open reduction and application of Lane plate. Same as No. 1.

oblique fractures with success. The only objection that I have found to these metal bands is the tendency they have to produce an unusual amount of callus. This callus is often of long standing, is removed very slowly by absorption and is liable to incarcerate important nerves, particularly in fractures of the humerus.

I have had some experience in bone grafting in fractures that have failed to unite. After treatment for ten or twelve months by the usual methods, I have used an inlay taken from the healthy tibia, held in place by bone screws made from the same tibia. This method has been very satisfactory and has caused a rapid union of the ununited bone. In preparing the diseased bone for the reception of the insert, we have found a very rarefied and softened condition of the diseased bone in the neighborhood of the fracture.

The treatment of fractures of the leg has been greatly simplified since the introduction of the steel pins of Steinmann, which are used to make extension of the leg. These pins are of various lengths and are passed through the os calcis. I prefer the pins to the tongs, as they secure a better and firmer hold of the os calcis. Since I have adopted the use of the pins, I find that it has not been necessary to make open operation as frequently as before. After as good a reduction has been made as possible, under either a general or local anesthetic (I find local is satisfactory in many cases), and a movable splint applied so that the splint can be removed daily and fracture examined, the fractured fragments can be massaged into place by degrees. With patient treatment, these badly comminuted

Plate No. 3.—Excessive callus production following use of aluminum band.

Plate No. 4.—Fracture of tibia and fibula, fragments maintained in position by use of screw.

fractures can be nicely adjusted, insuring a very satisfactory result.

During the last five years at the Morgan Park Hospital, I have treated twenty-eight fractures of fibula and tibia, forty of the fibula, thirty-six of the tibia, twelve of the femur, nine of the humerus, ten of the ulna and radius, sixteen of the radius, thirteen of the ulna, one of the pelvis, eight of the skull and three of the spine. I have treated one hundred and three cases of fractures of the small bones of the hands and feet. Out of these fractures of the small bones, for example, in the metacarpals and carpals of the hand, very few have been recognized as fractures without the aid of the *x*-ray. In other words, we could not elicit physical signs of fracture and many were not even suspected as being fractures; but as a result of our practice of taking *x*-rays for the purpose of making a record of the case, we have discovered, you might say, accidentally that there were fractures present. These cases have practically all been compensation cases that have received injuries at the works of the Minnesota Steel Company. It is, therefore, very important that these fractures should be discovered in order that we may be able to estimate the amount of disability that is liable to follow an injury of this kind. Then it is necessary, in order to protect ourselves against charlatans, both in the profession and outside, who are anxious to assist many of these cases in getting unjustified compensation—that is, compensation for injuries that did not exist. As an illustration, I will take a case of an employe of the Minnesota Steel Company, who had received an injury to his wrist. The injury consisted of a simple sprain and, in accordance with our practice, we made an *x*-ray picture and found there was no evidence of fracture of the bone. After some weeks of disability, on account of the sprain, he presented

Plate No. 5.—Jones fracture involving tuberosity of fifth metatarsal. Not recognized.

himself with a series of insurance papers. He was carrying insurance in several lodges and he suggested that, in order to get any money, it was necessary to get a report that the arm was broken, because the lodges that he belonged to would not pay for a sprain. Of course, we did not accede to his demand, but we heard later that he had consulted another physician, who had certified that his arm had been broken. This same patient came into the hospital some months later with a contusion over the collar bone; examination showed no sign of fracture; we also *x*-rayed the case and found no sign of fracture. Some weeks later he returned with an *x*-ray plate, taken by a physician nearby, who claimed that his collar bone was broken and he demanded compensation on account of the fracture of the collar bone. On inspection of the plate, we discovered what they thought was a fracture of the collar bone was the outer articulation of the clavicle with the acromion process of the scapula. As you know, this is united by cartilage together with strong fibrous ligaments that do not show up in the *x*-ray. This was pointed out to us as the seat of the fracture. We soon convinced him that there was no fracture, and that this appearance was a natural condition at this articulation. In all probability, he returned to the same physician, who filled out his insurance papers before certifying to a fracture of the clavicle.

In the industrial department of the Morgan Park Hospital, we come across these cases frequently. The treatments of fractures of the small bones of the foot are very simple, indeed; the patient usually rests in bed for a few days with hot fomentations applied until the swelling is reduced, then a plaster Paris cast applied; they are then discharged from the hospital and are allowed to go about on crutches. Fractures of the carpus and the metacarpus are easily adjusted and easily held in place by splints of metal and yucca wood, as are also the fractures of the phalanges. There is usually very little displacement of the fractures of the metatarsal and metacarpal bones; this probably accounts for the inability in many cases to make a diagnosis by ordinary methods and without the use of the *x*-ray. We will show you by lantern slides a few examples that were not recognized before the *x*-ray was taken.

Plate No. 6.—Fracture of second metatarsal unrecognized by medical attendant, patient worked at hard labor for period of three weeks. X-ray showed the fracture with no sign of healing. Union was prompt after proper treatment.

My experience in the treatment of fracture of the skull, extending over a period of thirty-five years, would include the treatment of about one hundred and fifty cases. Most of these men were injured by limbs of falling trees, while working as lumberjacks in the woods when the woods were near to Duluth. We would have ten or twelve injuries of this kind every year. Many of these fractures were very extensive and quite a few of them compounded. It has been our custom to make extensive flaps of the scalp and bone, widely exposing the dura, in order to remove blood clots and any displaced bone that may be causing a pressure upon the brain and at the same time securing bleeding vessels. In fractures that extend into the frontal sinus or into the petrous portion of the temporal bone, we place a drain, which is, in my opinion, a very important factor in the cure of these cases. Many of these cases seem to have almost entirely recovered from the injury and are perfectly normal mentally, when, after about a week or ten days, they suddenly develop meningitis, due, of course, to the extension

of the infection from the sinuses into the cerebrospinal fluid. For drains, we have used decalcified chicken bone to some extent, but mostly have depended upon a wick made of coarse catgut, leaving it in situ. This does away with the necessity of removing the drains. The chicken bone is finally absorbed, as is the catgut. I have found these very satisfactory drains in the fractures of the skull that need drainage. Then, a later complication that we have encountered is abscess of the brain. The patient recovers completely, to all appearances, from the fracture of the skull or brain injury, whatever it may be, but about three weeks or even later he begins to show symptoms of abscess of the brain. I believe that drainage in cases of fractures, where fractures extend into the frontal sinus or petrous portion of the temple bone, will frequently prevent the development of meningitis, as well as abscess of the brain.

I want to say a word about fracture of the spinal column involving the cord. In my early experience, we allowed all our broken-back men to die without attempting any operation. Some fifteen years or more ago, I adopted a method of operating upon all cases of fractures of the spine involving the cord. I have made twenty laminectomies in cases of this kind. Three recovered and one recovered as far as preserving life is concerned, but the patient is permanently paralyzed from the seat of the injury down and, in my opinion, will always remain so. The other three recovered to such an extent that they were able to walk again by the use of a cane when I last heard from them. I don't believe that it is always possible to judge before the spinal cord is exposed whether it has been completely severed or not. It seems to me that if the pressure by bone of the broken arch is sufficiently made upon the cord that it would produce complete paralysis and, at least in one of my cases, we found that the cord was compressed by a smooth piece of the broken arch and after the pressure was removed he soon began to show signs of movement in his limbs and finally recovered sufficiently to walk with the aid of a cane.

The fractures that often produce the most serious complications are fractures of the pelvis. This is particularly so in the fracture of the pubic portion in which a sliver of bone divides the urethra. This accident produces a condition that often proves fatal when not immediately recognized and overcome by prompt operation. This is a condition that is easily diagnosed. There is no excuse for a physician of average experience and intelligence to fail to make a diagnosis before the urinary infiltration has taken place in the perineal region; however, many cases go undiagnosed and die from urinary infiltration and sepsis. The inability to pass a catheter together with the dribbling of a little blood or bloody urine from meatus following a receipt of an injury is sufficient to suspect at least a rupture of the urethra.

I will say, in closing this paper, that to obtain the best results it is necessary to make good use of the *x*-ray; at the same time remembering that *x*-ray pictures are not photographs of bones, but that they are photographs of shadows of bones and that these shadows are often distorted in such a way that correct interpretation is sometimes difficult and often deformities are greatly exaggerated as they appear on the plate.

RECENT DEVELOPMENTS IN *X*-RAY APPARATUS* *

A. MUTSCHELLER, Ph.D.*
New York

During the last few years such important physical and technical advances have been made with the aid of the *x*-rays that it might not be far from correct to class the discovery of Professor Roentgen as one of the most important of the last quarter of a century. Aside from the enormously useful field of application which the *x*-rays have found in medicine, we have to credit to this discovery our present definite knowledge of the structure of crystals, the arrangement of the atoms and molecules in solids, a method of identifying the atoms and of classifying them, from their *x*-ray spectra, in a periodic series, a method of studying the structure of metals and alloys and finally the use of the *x*-rays for sterilizing substances such as tobacco, cheese, etc.

This very interesting as well as useful subject has engaged many and the best workers in the field and very rapid technical advances are therefore not surprising. There is an interesting sequence of improvements in *x*-ray tubes, and in step with these followed improvements in the design of *x*-ray apparatus. In fact, even a superficial inspection of a

*From the Research Laboratory of the Wappler Electric Co., Inc.

**A lecture delivered before the Minnesota Section of the American Institute of Electrical Engineers at the University of Minnesota, Minneapolis, Minn., November 28, 1921.

modern machine suffices to convince anyone that it is a highly specialized apparatus, designed and constructed in accordance with definite and specific intentions.

Here arises the question: What are the given conditions to which an *x*-ray apparatus must conform, or what are the specifications for an engineer who is charged with the design and construction of an *x*-ray apparatus? In arranging the subject of this lecture, I found it convenient to divide it into the headings: (1) radiographic, (2) physical or technical, (3) engineering or commercial requirements.

RADIOGRAPHIC REQUIREMENTS

Considered from the *radiographer's* standpoint, the most essential requirement is that the apparatus be safe in respect to fire risk, break-down and accidents which might bring the patient or the operator into danger. A designing engineer must therefore be acquainted with practical radiographic work, with medical practice and with actual conditions under which the apparatus is to be used; he must therefore be able to place himself in the position of the roentgenologist and he should know what conditions may arise in the *x*-ray laboratory and how accidents generally occur. Imagine, for instance, that a patient in great agony is brought into the *x*-ray department. There he is placed on the *x*-ray table and is to be turned into several different positions, and, while orderlies or nurses may be busy in the same room, it is necessary to pass from 50 to 100 milliamperes of current at from 40,000 to 60,000 volts through the tube, which is generally at a distance of from 10 to 15 inches from the patient. If you, as electrical engineers, would see a nervous and restless patient under such conditions, you would probably immediately begin to think of safety devices and to figure out what protection should be provided against the accident which would result if the patient should move an arm or a leg and come in contact with the tube or one of the high tension wires; or if a patient is not examined in the hospital, but is in the doctor's private office, it very often happens that "to have someone's *x*-ray picture taken" is a family affair which is generally well attended by the relatives of the patient. The ways in which these people manage to come in contact with the high tension wires are really ingenious. Thus, we have only to consider such hidden dangers as the wire construction of women's hats and the tinsel fabrics in their clothing, which are all excellent conductors of high voltage electricity. Moreover, it is impossible to consider lightly the effects of giving shocks to bystanders, especially since, in the present era of highly developed legal skill, such accidents very often prove efficient in extracting damages which are then alleged to have been due to negligence on the part of the roentgenologist.

But it is not an electrical engineer making such *x*-ray exposures; this work is performed by a medical doctor, who, as a rule, is unfamiliar with engineering subjects or the physics of electricity; his interest is centered primarily on the patient; thus, he generally forgets all directions and instructions which may have been given to him by the manufacturer who installed the apparatus. For that reason, *x*-ray apparatus must be constructed so that their control gives as little chance for error as possible, and, in addition to this, the installation must be such that the operator has the patient and the high tension current carrying part of the wiring in full view while the current is applied, so that in case of danger or accident he is ready to pull the controlling switch and stop the current.

A modern *x*-ray laboratory is generally arranged so that the operator and the patient are protected as much as possible against the rays. The control board is usually located behind a lead-lined panel or in a lead-lined booth provided with a lead glass window through which the operator can observe the patient and the tube. Numerous safety devices have been suggested, but, while some of them may offer some protection, they all suffer from the serious defect of not being absolutely dependable. Hence, the sense of false security created through the use of such safety devices makes it very doubtful whether it is not better that the operator be fully aware that he is controlling a current which under certain conditions may be very dangerous to life, as it is practically equal in power to that used, for instance, in the New York State Prison for electrocution, rather than to have him depend on the less reliable protection afforded by mechanical or electrical devices.

For the direct visible examination of patients with the fluoroscopic screen, there is, as a rule, less electrical energy required and consequently the dangers appear to be less; nevertheless, there are a number of deaths on record, which have occurred in the fluoroscopic room, so that here again absolute protection against high tension shocks is necessary. The fluoroscopic room must be darkened during the examination; the noise of the *x*-ray machine and the nitric fumes produced by the high tension

current causes many patients, especially those of the anemic type, to faint. Protection against the possibility of high tension shock is therefore as important in the fluoroscopic room as it is in the regular *x*-ray laboratory, where ordinarily larger energies are applied to the tube.

A still greater problem for providing protection against the *x*-rays and the high tension current is presented in the modern therapeutic *x*-ray laboratory. In the crusade against cancer, the *x*-rays seem to be one of the important effective weapons against that disease, if it is not too far advanced. *X*-ray therapy has been practiced in this country for a number of years and apparently with good results, at least for the treatment of superficial cancer or similar superficial malignant or semi-malignant diseases. The use of radium, which was very strongly advocated during the last decade, seems to have proven somewhat of a disappointment except in some cases where the radium needles can be introduced directly into the diseased part. But, when the malignant growth is located beneath the skin or deep in the tissue, the rays of radium do not seem to prove efficient in destroying the disease.

X-rays can be produced with sufficient penetrative power and in sufficient quantities to enable one to deliver a destructive dose even to deeply located malignant growths. The main difficulty, however, arises in protecting the part through which the rays enter against overdose, for the incident dose is always considerably larger and more effective than the dose delivered to the part located deeper in the tissue.[1] Physicists have faithfully collaborated in this work and they have made careful studies to determine what quality of rays would be most suitable to obtain the desired destructive effect on the deep-seated growth without at the same time injuring the surface layers and the skin through which the rays must pass. When the action of a given *x*-ray radiation is considered proportional to the fraction absorbed in the tissues, it is calculated that voltages between 80 and 100 kilovolts would be most adequate for delivering to a deep-seated tumor the largest dose which can be given without overdosing the skin layers. Thus, until about three years ago, practically all *x*-ray treatment of deep-seated cancer was given with potentials ranging between 80,000 and 100,000 volts.

With the termination of the European war, reports came from abroad to the effect that much better results could be obtained with voltages considerably higher than those used in this country. In fact, it is reported by roentgenologists who have visited European clinics that the surgeons in charge of some of those clinics have discontinued taking surgical procedure against certain kinds of cancer and prefer to send their patients to the *x*-ray laboratory for treatment, where, as the reports stated, they are in most cases actually cured. In fact, the routine there seems to be, first, the application of *x*-rays and then, if the desired result is not obtained, surgery is resorted to. The theory advanced by these roentgen physicists is that the higher penetrating rays produce more scattered radiations and that, contrary to the belief of American physicists three years ago, the effects of the *x*-rays in deep therapy are not entirely due to the absorbed portions, but rather to the portion scattered in the tissues.[2]

Quite a number of roentgenologists in this country have tested this new method. Their results in general seem to confirm the European reports and thus clinical results have shown a new direction. Since then physical measurements on scattered radiations have been in progress in this country and so far it has been shown that as much as from 60 to 80 per cent of the effects of highly penetrating radiations are due to radiation scattered in the tissue.

Under these circumstances, a new problem arose for the *x*-ray engineer—that of constructing an *x*-ray transformer producing and rectifying a high tension unidirectional current of from 250,000 to 300,000 volts. This is a difficult task and the requirements for insulation and safety are indeed difficult to fulfill, but a solution to the problem was found in the new type deep therapy machine, several of which have now been in operation for many months, delivering from 5 to 8 ma. at from 260,000 to 280,000 volts peak value.

PHYSICAL REQUIREMENTS

The preceding remarks are made with the inten-

[1] Attention is called to the necessity of correct dosage because a small dose which is insufficient to destroy the cancerous growth, may stimulate its vitality; hence an insufficient dose may, under certain conditions, be more harmful than useful.

[2] It is now known that the effects of an absorbed radiation can be expressed as the sum of two factors

$$\mu = \beta + \sigma$$

β being due to the energy absorbed in accordance with the classical absorption law ($I_t = I_0 e^{-\lambda t}$) and σ the part which is scattered in the mass of the tissue. The older calculations of dosage were solely on absorption (β) and the scattering effects (σ) (which seem to be most pronounced with the higher penetrating rays) were neglected; but studies on scattered radiations are now in progress.

tion of showing that the roentgenologist's requirements must be fully considered by the designing engineer. So far I have omitted all reference to *physical* or *technical* requirements and those which might be considered as having originated in connection with the *x*-ray tube. But, as a rule, improvements in *x*-ray apparatus have been preceded by improvements in *x*-ray tubes. So, for instance, the old type platinum target tube was energized from the now discarded induction coil; then followed the invention of the tungsten target tube, which permits a much larger energy input. This gave an impetus to the engineers and resulted in the creation of the modern transformer rectifier type machine. Again, when the various types of hot cathode tubes had been fully worked out, some new accessory apparatus came into use, and finally, when the new deep therapy tube was perfected, there were again new requirements and another new type of apparatus was promptly designed and developed. These cases illustrate the fact that engineers have solved the new problems as promptly as they arose or as soon as the requirements and specifications were definitely formulated and presented to them. It is therefore in a way surprising that the literature contains nothing like a set of specifications which might serve as a guide to engineers in constructing *x*-ray apparatus. In preparing this paper, therefore, I undertook to enumerate some of the most important requirements, and I hope that I succeed at least in pointing out the direction in which some of the still existing problems might be solved.

From the fact that an *x*-ray machine converts energy taken from the power supply line into such energy as is suitable for the production of *x*-rays, it follows that the required electrical characteristics of the current produced, i. e., its curve form, voltage, power factor, etc., are determined entirely by the characteristics of the tube. A designing engineer must therefore be fully acquainted with the physics of the *x*-ray tube, or there must be a physicist who can describe definitely the kind of current which must be produced. In the following we shall consider briefly the two types of *x*-ray tubes now in use, namely, the ionic or gas containing tube, and the electronic or high vacuum tube, of which the Coolidge and Lilienfeld tubes are examples.

The gas containing tube is still used extensively because of some of its properties and characteristics which make it very valuable and in certain respects preferable to the electronic tube, although it is a little more difficult to operate. A gas containing tube, shown in Figure 1, consists of two principal electrodes and an air-tight envelope, usually of glass, which, of course, must be a good dielectric to prevent discharges through it or along it, and which must enable one to evacuate and maintain the tube at the required degree of vacuum. The electrode to which the negative potential is applied is spherically curved, the curvature being approximately focused upon the second electrode, which faces it and which is placed at a distance of about 3 to 4 inches away from it. There are a certain number of gas molecules left in the evacuated space as well as a number of ionized positive and negative gas particles, and when a difference of potential is applied the positive ions are attracted toward the negative electrode. When impinging there they give off their charge and cause the release of electrons. These electrons are then accelerated in the electric field and by virtue of the curvature of the negative electrode are caused to impinge upon a small area on the other electrode, which faces the discharge. The opposing electrode, which is generally called the anticathode, consists of a tungsten surface which abruptly stops the electrons and thereby excites the *x*-ray radiation. The tungsten target is mounted on a block of copper which rapidly carries away the heat generated on the target through the electronic bombardment.[3]

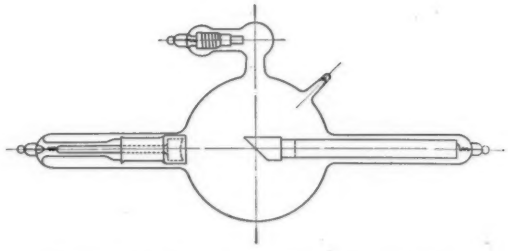


Figure 1. Tonic or gas containing x-ray tube.

The frequency of the impact of the ions on the cathode is proportional to the strength of the electrical field and therefore proportional to the voltage applied to the tube. The tube therefore obeys Ohm's law except that the voltage factor, being a kinetic energy or a velocity component, must be squared. The current therefore increases with an increase in the voltage applied to the tube and at the same time the velocity of the electrons through

[3] A third terminal is provided so that by shunting some current through it a certain amount of gas can be liberated until the degree of vacuum is properly adjusted.

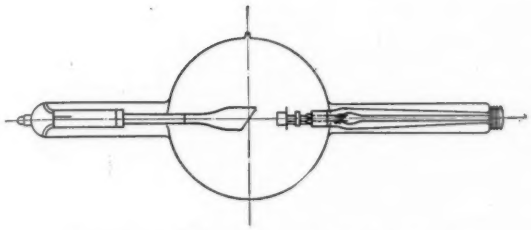


Figure 2. Electronic (Coolidge) x-ray tube.

which the *x*-rays are produced increases so that, by applying higher voltages to the tube, rays of proportionally higher penetration and in greater quantity are produced.

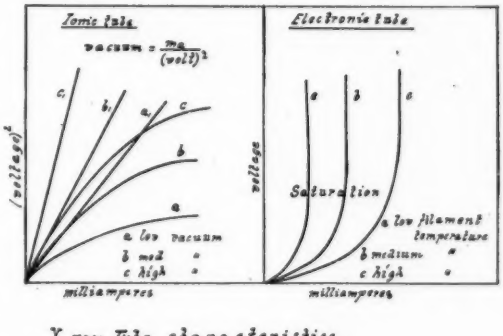
The second, or electronic tube, known as the Coolidge tube (Fig. 2), also consists of two principal electrodes and a space limited by a gas-tight envelope; but this tube is evacuated to the highest degree possible. The release of electrons is there fore not obtained through the impact of positive ions upon the cathode, but it is produced from a heated surface in the cathode. The electrons emitted in the cathode are then focused electrostatically upon the second electrode, which faces the electron stream.

The characteristics of this tube differ from those of the gas tube in that, with rising voltage, the current increases very rapidly until it arrives at a so-called saturation condition, at which the current is then independent of the voltage applied to the tube and is therefore solely proportional to the temperature of the filament. This type of tube therefore does not obey Ohm's law or a modified form of it, but represents a rigid system which allows current to pass entirely independent of the voltage applied and determined only by the temperature of the filament.

The manner in which the tube current and the voltage across the two types of tubes change is shown in Figure 3, where curves a, b and c are obtained with a gas tube of three different degrees of vacuum and curves a′, b′, c′ are obtained by plotting the square of the voltage against the milliamperes. The resistance of the gas tube therefore is of the type of Ohmic resistance, but in the formula for Ohm's law the voltage must be squared. The curves of the electronic tube a, b, and c were obtained with three different degrees of filament heat. The vertical parts represent the condition of saturation, and the tube current is therefore clearly shown to be independent of the voltage across the tube.

This brings us to the question of deriving some of the electrical conditions to which the current produced in the *x*-ray machine must conform, so that it will properly energize both types of *x*-ray tubes now in use. The gas containing tube will work perfectly well and regularly, provided its vacuum remains unchanged, but as soon as the electrodes become hot they release some of the gas occluded in the mass of the metal, with the result that the vacuum drops and the resistance of the tube decreases. In such a case, if the *x*-ray machine maintains a constant potential, irrespective of the tube current, the current through the tube will increase at the rate at which the vacuum drops and it may finally become large enough to either injure the target or crack the glass. In practice, however, it has been found that if there is sufficient Ohmic resistance in the primary of the transformer, the increased RI^2 loss in the resistance, in case the current tends to increase, will practically compensate and prevent the damaging of the tube. For this reason, therefore, gas containing tubes are almost exclusively operated with rheostat controlled machines.

Moreover, in the hot cathode tube, the current depends upon the temperature of the filament and the voltage can be varied independent of the tube current. For that reason, it is feasible to make use of the very convenient method of varying the secondary voltage with an auto transformer in the primary through which the voltage impressed upon the transformer can be conveniently regulated.



X ray Tube characteristics.

Figure 3.

With this tube, therefore, all ballast resistance could be removed from the primary, but then the tube alone will be depended upon to withhold all the reserve energy of the line except that for which the

filament is adjusted. While this system of control is very convenient and very interesting from the engineering point of view, it offers the serious objection that, should a patient come in contact with one of the wires, or with the tube, the power of the machine, being practically unlimited, would certainly do serious damage before the fuses blow or some part of the wiring burns out and interrupts the current. Other sources of danger from this auto transformer, or constant voltage control, may arise when the filament heating current is interrupted either through a loose contact, breaking of the filament or by accidentally forgetting to turn on the filament current. It appears, therefore, that while this system of control may be very convenient, its recommendation is hardly justified in view of the existing danger. However, with a rheostat through which the current volume can be limited to the desired current for which the tube is adjusted, the auto transformer control is made safe without sacrificing any of its desirable advantages.

ENGINEERING AND COMMERCIAL REQUIREMENTS

From the engineering and commercial standpoint, there are also a number of problems which are not at all easily solved. We have only to consider the difficulties in generating and distributing high tension currents with which the engineers in that special branch are fully acquainted. The normal insulative strength required for a given high voltage may be easily provided; but when surges and oscillations develop in the high tension circuit, it is found that the electrical dimensions and precautions must be doubled or tripled; otherwise, break-down of the system must be expected.

1. *Surges.* — In *x*-ray machines, surges occur very often because of abnormal conditions developing along the line and in the tube. For instance, when some of the target metal is vaporized and deposited on the inside of the bulb or when dust, which is very strongly attracted, forms a layer on the outside of the bulb, a strong condenser action is set up which gives rise to surges that may become violent enough to break down a poorly constructed transformer or they may puncture the *x*-ray tube and render it useless. With the very high voltage machines already referred to, which are used for deep therapy, the disturbing effect of surges is very pronounced and special devices, which will be described later, have to be employed to dampen them so as to make them harmless.

2. *Unsuitable Location.* — Very often, due to lack of space, an *x*-ray machine is placed in a damp and poorly ventilated room. That this mistake cannot be made with impunity is easily plausible to high tension engineers; nevertheless, physicians very often make the mistake and place the *x*-ray machine into a room for which they have no other use. Here again, it is the engineer's task to see that such experiments are not repeated, for all previous ones have resulted in failure and disappointment.

Many other disturbances arise from improper care of the apparatus. I just wish to mention as one example that in several cases the color of high tension insulators was not in agreement with the esthetic sense of the medical doctor or the decorator; this prompted them to place a coat of paint on the insulator, and, for some reason or other, they generally select the well-conducting lead or zinc oxide. Quite a number of doctors also prefer to personally install the aerial wires which connect the tube to the machine. They very often use new or wet wood for insulation and are also very eager to embellish their products by gilding, painting or staining the wood with conducting material. The break-down of these defective insulators, however, does not always develop at once, but comes gradually, and the leakage of current resulting therefrom places an increased load on the transformer, and, if it does not actually break down, the leakage creates the false impression that the transformer has broken down.

The possibility of such unexpected burdens must be considered in addition to the exceedingly strenuous use to which an *x*-ray transformer is put. The time of exposure, especially if made with a large energy, is usually only a fraction of a second. To avoid a drop of potential when the exposure is made, heavier feed wires must be selected than would generally be chosen for the power taken from the line. This sudden drawing of heavy current from a supply line of low resistance naturally places far more strain on the *x*-ray machine than if the same power were consumed steadily and less abruptly.

3. *Transformer.* — The transformer used for *x*-ray purposes must naturally have a very high transformation ratio for transforming the commercial line voltages to the desired 120,000 to 150,000 volts. Since the total power consumed per year in an *x*-ray machine is almost negligible, its efficiency may be considerably lower than in the usual power transformers. There are good *x*-ray transformers

in use with from 75 to 85 per cent efficiency at full load, but this low efficiency must not be the result of poor construction, but should be entirely due to adequate spacing between the primary and secondary coils, so that there is the best possible protection against break-down between the coils. The coils must be wound with utmost care and the best possible insulation must be provided. To insure good results, the core of the transformer should consist of the best laminated transformer iron and the layers should be separated from each other by a film of good varnish. For the oil and the tank, the usual rules for good engineering must be observed.

4. *Rectifier.*—The installation of the high tension carrying parts and the rectifying segments offers a problem of considerable importance, for any break-down in the insulative strength of the material used will surely result in an interruption of the performance of the machine and very often the trouble is not readily found.

5. *Feeders.*—A moment ago, I referred to the necessity of connecting the *x*-ray machine to feeders which are of larger size than those generally selected for similar power consumption. Very often electrical engineers inquire about the capacity of the machine to be installed and then, according to the information given, they select the size of wire for the feeders. In the writer's experience, it has happened at least a dozen times, that feed wires installed the day before had to be taken out and replaced by heavier ones. But this was not the fault of the engineer, who acted correctly, according to the information given him; but the mistake lies in rating *x*-ray machines in the same terminology and according to the same standards as motors and power transformers. The principal requisite for an *x*-ray machine is that it should deliver a certain high voltage and that this voltage should be maintained uniformly when the *x*-ray switch is closed, i. e., without any initial high voltage kick followed by a drop to a lower voltage.

Another important reason for heavy feeders is to secure a uniform line voltage. Since a comparatively small fluctuation in the supply line causes a considerable change of voltage in the secondary circuit, it can easily be seen that such fluctuations make the operation of the *x*-ray tube unsteady and difficult to control. Moreover, when a hot cathode tube is used and the filament heating transformer is fed from the same line as the *x*-ray machine, the existing fluctuations, or those resulting from closing the *x*-ray switch, are extremely annoying, and very often in country districts, where heavy loads are on the same transformer, it is impossible to use the hot cathode tube satisfactorily.

6. *Grounding.* — Still another electrical point which, if neglected, will sooner or later lead to accidents and break-down, is the necessity of connecting certain parts of the *x*-ray machine to the ground. As a rule, the motor case and the frame upon which it rests must be grounded. For the purpose of properly balancing the secondary circuit, a certain point in it is maintained at ground potential. It is generally the middle part of the secondary, but it may be any other point which may be arbitrarily chosen or which is determined by the type of tube to be used.

Many break-downs and disturbances are due to improper grounding of the apparatus and this point cannot be too strongly emphasized, because in one out of every two cases of accident the medical doctor or an inexperienced electrician is found to have been negligent. Grounding means the establishing of good electrical low resistance contact between the electrical apparatus and the wet ground. If the usual grounding conductors are tested, it is found that only water pipes containing water are sufficient; gas pipes, steam heating systems, and the metal framework of buildings, etc., are insufficient, for very often they are temporarily disconnected from the ground. When using the neutral of a three-wire system for grounding, it must consist of a somewhat heavier wire than usually employed and must not be fused. As a rule, it is hard to reconcile an electrician to this fact, especially if his training has only been in rules of thumb and not in the actual physics of electricity. But the fusing of a ground wire would be just as irrational as attempting to protect a steam boiler by closing the safety escape valve.

DESCRIPTION OF SOME MODERN TYPES OF APPARATUS

The *x*-ray machines now in use are of the transformer rectifier type, in which the alternating current is commuted and delivered to the tube as a unidirectional pulsating high tension current; a second type of apparatus, generally of smaller capacity, delivers non-rectified, i. e., alternating, high voltage current directly to the tube. A schematic wiring diagram of a transformer-rectifier apparatus is shown in Figure 4. This apparatus is a combination of rheostat and auto transformer control and is therefore suitable for energizing both the gas and the electronic type *x*-ray tubes. The

auto transformer is shown with variable taps, so that the secondary voltage can be varied between the practical limits of 30,000 and 120,000 volts. The rheostat is calibrated in steps so that, with the gas containing tube, uniform increases in voltage and milliamperes of tube current are obtained as we move the rheostat lever from the lower to the higher buttons. The high tension transformer, which may be either of the core or shell type, has a primary winding, as a rule, located beneath the secondary winding coils. In former years the transformers were dry insulated with a wax compound, but the desire to decrease the risk of injury in shipment prompted all manufacturers to insulate and cool the transformers with oil. The two terminals of the secondary of the transformer terminate in two brushes which face a rotating micanite disc on which two segments establish contact with a second set of brushes, and these are connected to the terminals of the tube. The micanite disc, which is rotated by a synchronous motor connected to the same power line as the transformer, is adjusted so that the segments of the disc make contact between the brushes at the moment when the current curve is at its maximum. By making the segments on the disc of the proper length, it is possible to select just the middle portion of the curve and to omit the ascending and descending or "foot" part of the curve, which is of lower voltage and which would therefore produce rays of insufficient penetrative power. Connected to the same supply line is a small step-down transformer, which supplies a heating current of approximately 12 volts to the filament of the electronic tube. This transformer

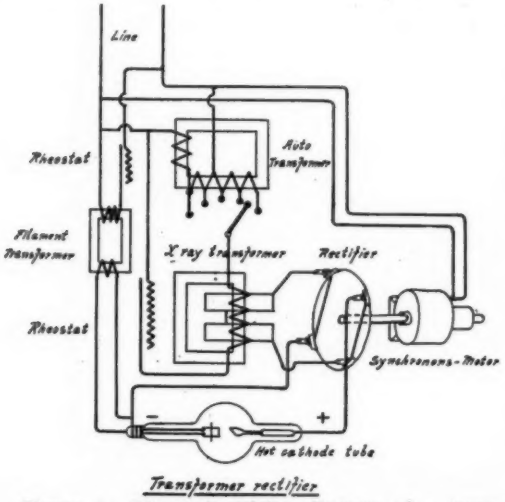


Figure 4. Schematic wiring diagram of a transformer rectifier x-ray apparatus.

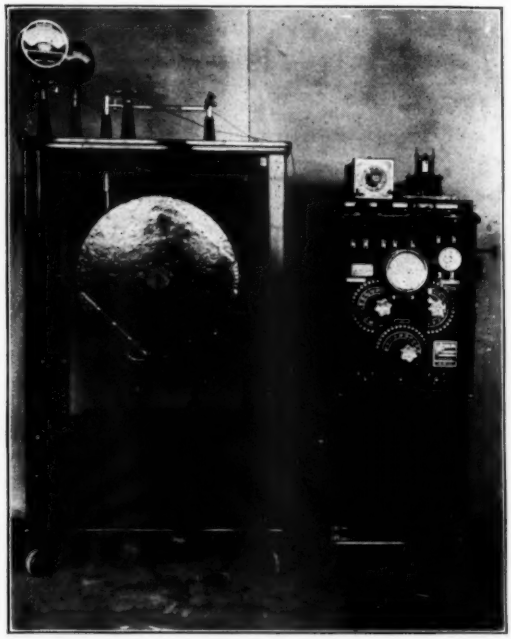


Figure 5. X-ray machine with front glass panel removed.

is not required for operating the gas containing tube.

A front view of a machine of this type is shown in Figure 5, which shows the micanite disc with two cross strips making contact between the transformer terminals and the terminals on top of the machine, which are connected to the tube. The switchboard is generally constructed as a separate unit and contains a voltmeter connected across the primary, an indicator showing the polarity of the rectified current, a control in large steps and one giving a finer gradation for the auto transformer, and a rheostat. All these switches, including the fuses, are placed beneath a plate glass panel so that only the insulated switch handles and regulating knobs project. Thus, if the machine is operated in the dark, there is no danger of the doctor coming in contact with any live or current-carrying part of the apparatus. Figure 6 shows the same machine and switchboard from the rear. The transformer tank is located in the lower part of the cabinet and two mica insulated leads carry the alternating current to the two horizontal brushes, which are supported by a pair of insulating arms. The connections to the tube are from the two vertical brushes, also carried on a pair of insulating arms. The synchronous motor is shown in front of the disc.

The mechanism of the rectification can be easily

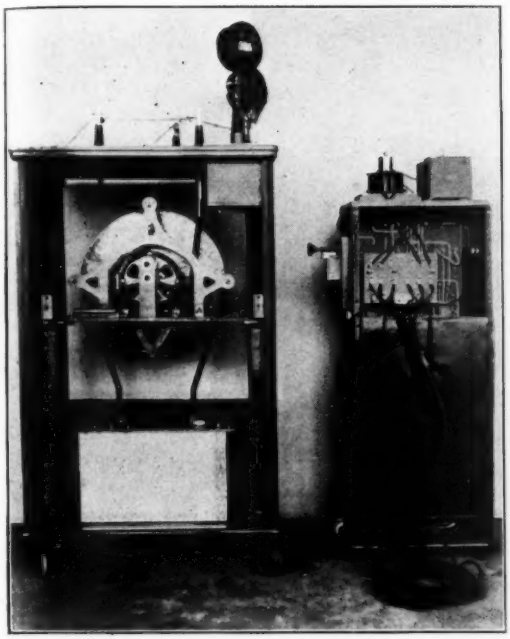


Figure 6. X-ray machine and switchboard from rear; the back cover of the machine is removed; the switchboard is partly open.

traced from the visible connections. If we assume that at this moment, with the disc in the position shown in Figure 7, the positive potential is on the right transformer terminal, then the same potential will appear on the right terminal on top of the machine; the terminal on the left, on top of the machine, will naturally be negative and connected to the cathode of the tube. However, for the next half cycle, when negative potential is developed on the left terminal of the transformer, the disc will have rotated through 90° and the segments will be in a position which will change the polarity so that, as before, the positive polarity impulse is again delivered at the right terminal on top of the machine and the negative at the left. The function of this rectifying mechanism is therefore that of a periodic synchronous pole changer for the high tension current.

Figure 8 shows the switchboard more in detail. In the lower part is located the auto transformer, which is connected to the dial buttons by means of asbestos-covered wires. Separated with a heavy board of asbestos and behind the auto transformer are the rheostat coils, which are also connected to the buttons of the rheostat dial by means of asbestos-covered wires. On the right upper part of the

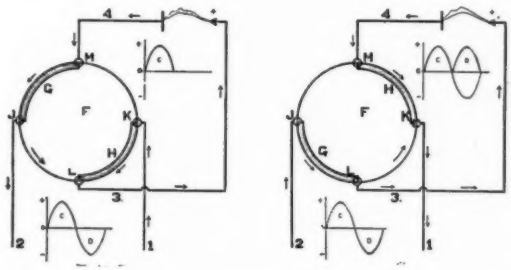


Figure 7. Diagram showing the mechanism of current rectification by the high tension rectifying device.

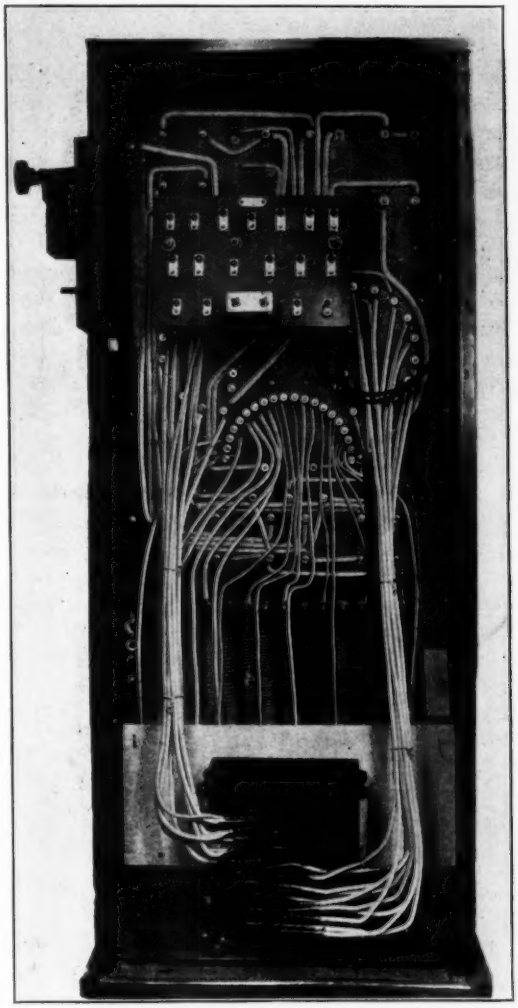


Figure 8. Switchboard seen from rear with back cover removed, showing the rheostat coils and the auto-transformer in front of the coils.

control board there is a regulator for the voltage of the filament heating transformer. It is of the inductance type and the regulation is obtained through varying the magnetic flux by displacing the pole piece, which closes the open electro-magnet. This type of control has the advantage over the resistance control in that it is more constant and does not change because of heating. As can be seen from this figure, after the cabinet is closed, there are no current carrying parts on the outside of the control board and this is an important feature, because very often the machine is operated in the dark and it is exceedingly irritating to an operator to receive small shocks which one can get by coming in contact with low tension switches.

A somewhat simpler type of *x*-ray machine is shown diagrammatically in Figure 9. This also consists of an auto transformer, a step-up transformer and a filament heating circuit, but it has no current rectifying device. This type of apparatus is adapted only for operating the electronic type tube with a heated cathode. In this apparatus the cathode side is maintained at ground potential and the positive side of the tube is connected to the active terminal of the transformer. This offers the advantage that the winding in which the filament heating current is induced can be placed directly on the auto transformer core. The auto transformer core is magnetically saturated so that any fluctuations which

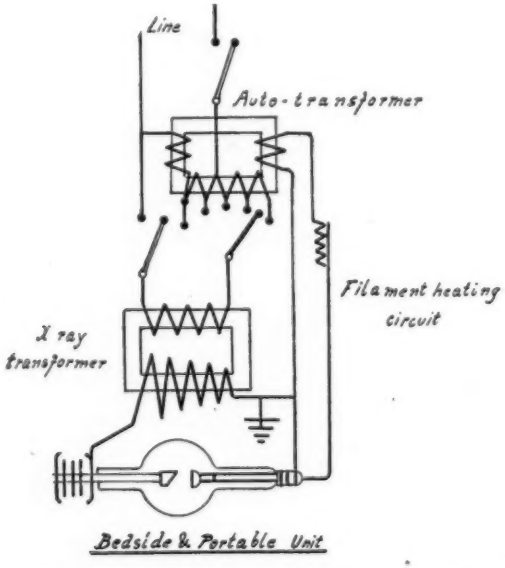


Figure 9. Schematic wiring diagram of bedside and portable type of x-ray apparatus.

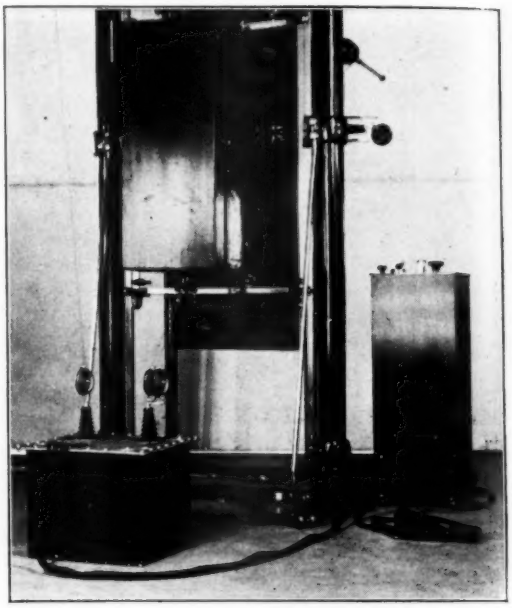


Figure 10. Fluoroscopic unit connected to a vertical fluoroscope.

may exist across the line are either entirely suppressed or very effectively compensated. With this system, an excellent voltage stabilizing feature is obtained. The transformer construction is also simplified in that only one live terminal is present and naturally only one side of the transformer requires insulation for high voltage. This type of apparatus is only used for low capacity units such as are employed for portable work, for fluoroscopy, or for emergency radiographic work.

Figure 10 shows such a unit employed for fluoroscopic purposes. The control is near the operator and enables him to regulate the secondary current and the filament temperature to any desired degree, while performing the fluoroscopic examination, and the transformer current is closed by means of a foot-switch.

Figure 11 shows the switchboard of this unit. There is a regulating knob for the filament current and one for adjusting the secondary voltage. The currents are indicated by the two meters. Contrary to former practice, the control of the tube and its operation is entirely according to meter readings.

The latest addition to the already large family of *x*-ray machines is represented schematically in Figure 12, which shows the electrical construction of the modern "deep therapy machine." This con-

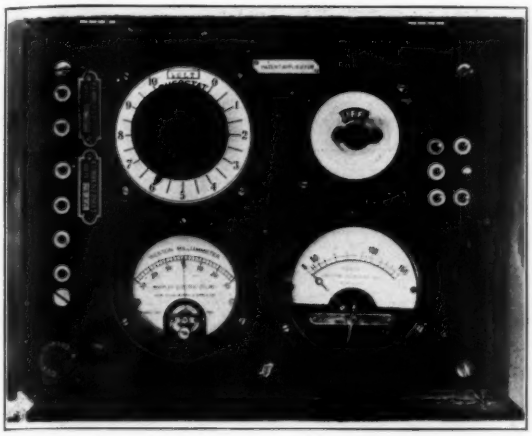


Figure 11. Switch control board of a portable x-ray unit.

sists of two separate oil immersed transformers, two rectifying discs driven by one synchronous motor, a regulating rheostat, a damping device, which is represented conventionally as a resistance grounded in the middle, and then, for the heating of the filament of the electronic tube, a step-down transformer with a current regulator. The machine is practically made up of two units of the type previously described, which are connected with each other and coact in such a way that each transformer develops a difference of potential opposite to that of the other, and when applied to the two ends of the tube their voltages are added to a total maximum potential difference of 300,000 volts. This is made possible by maintaining the secondary at ground potential at a point between the two transformers. The two voltages are then developed on one leg of each secondary while the other two legs are connected with each other and with the ground. It is thereby possible to place the motor and the platform upon which it rests between the two transformers and then mount rectifying discs at the two ends of the motor shaft. The oscillation damping device previously referred to consists of resistances, in magnitude of the order of the resistance of the tube, and these are so placed in the high voltage circuit that the loads of the tube and the resistances are equally distributed on both sides of the secondaries of the two transformers. This equal distribution of the loads at the secondaries lessens the electrical strain on the windings and at the same time, if properly balanced, suppresses all oscillations and surges which would form in the absence of these damping resistances.

When we first undertook the construction of the deep therapy machine it was found that oscillations and surges occurred much more frequently and violently than in the machines hitherto used, probably because of the higher transformer ratio and the much higher voltage current to be rectified by mechanical rectifiers. These oscillations and surges become evident through the formation of extensive corona and ozone along the wires, the flickering of the tube and the tendency of the current to discharge along the tube arm, from which puncturing of the glass wall is likely to result. There may also be sparking to the tube shield usually employed to protect the patient and the operator against stray radiations. When charged with such high voltage current, these parts attract dust particles electrostatically and this deposit greatly facilitates discharges along the glass walls to the grounded tube-stand. For this reason, all possibility of operating the machine at the desired high voltage depended almost entirely on the discovery of an effective means for preventing the formation of these disturbing oscillations. From an analysis of the electrical conditions presented in this case, there might have been several solutions to the problem, but we found that by connecting glass tubes filled with water or high resistance silundum rods into the secondary circuits, the oscillations were effectively suppressed. It was then merely a question of properly balancing the circuits and placing the resistances so that the best protection for the transformer secondaries would be obtained.

The importance of such a device may be illustrated by the fact that the new deep therapy *x*-ray tube manufactured by the General Electric Co. is rated for a maximum of 200,000 volts, which is

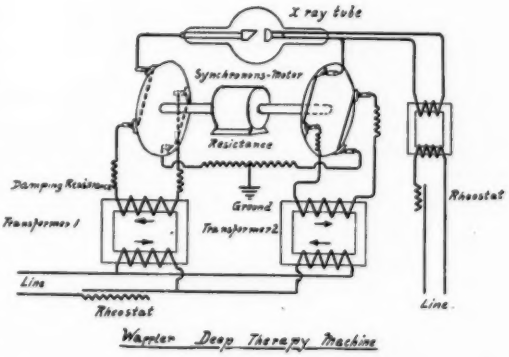


Figure 12. Schematic wiring diagram of a high-voltage deep therapy x-ray apparatus.

equal to a spark jumping 14 inches between points in air. When such a tube is run on a machine in which the oscillations are not eliminated, there is distinct distress shown as soon as this voltage is exceeded. However, with a properly balanced machine, we are able to run the same tube continuously with a potential of from 260,000 to 280,000 volts, which voltage will jump a gap of 18 inches between points in air. Machines built according to this principle have now been in operation in a number of clinics for several months and so far there has been no disturbance nor accident either in the machine or in the tube.

Figure 13 shows the interior of the deep therapy machine. In the center there is a synchronous motor mounted on an iron platform and on this platform there are two metal frames, each of which carries 4 high tension insulators projecting in opposite directions. On each end of the motor shaft there is a rectifying disc. These are cut out to the form of a cross, for we found that the resistance offered by narrow edges in cutting through the air is over 50 per cent less than the surface friction produced on a round disc of the same diameter. By shaping the discs in this manner we are able to use, for the two discs, a motor of the size employed for smaller machines with a single circular disc without any risk of the motor dropping out of synchronism. We also found in general that the mechanical strain on the motor and the resistance of the peripheral air friction of this rectifier are very much less, and therefore the entire double rectifying mechanism requires considerably less power than when circular rectifying discs are used. Still another advantage was found in the cross-shaped disc, namely, that the undesirable air blast which is set up by a circular disc and which has a tendency to blow oscillating arcs when the segments make contact with the brushes is very much decreased.

About midway between the rectifying mechanism and the iron frame are two large stationary mica discs which are very effective in stopping the creeping effect of the high tension current along the insulators, which becomes very disturbing when dust or moisture has deposited on the insulators. The resistances used for damping the oscillations can be seen in the two front conductors from the transformer to the rectifier and a second set is located in the transverse channel shown directly beneath the platform. The ground is made in the middle of these resistances. The two high tension transformer tanks are located in the lower part of the cabinet and the transformer for the filament circuit is in the center of the rear upper part of the cabinet.

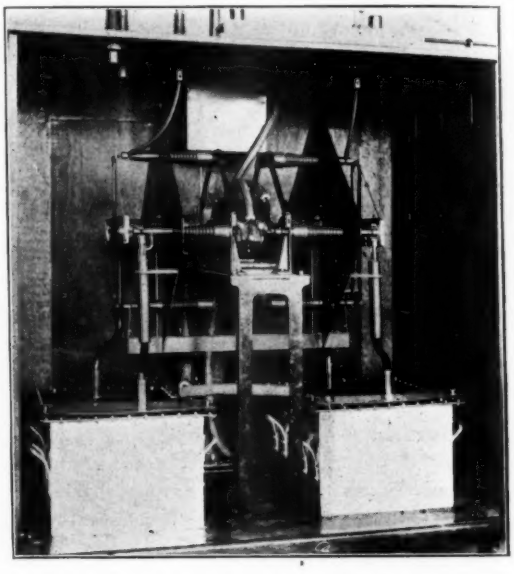


Figure 13. Deep therapy x-ray machine, front part of cabinet removed.

It may easily be seen from this figure that the grounded part of the apparatus and the low tension current carrying parts are all located in the center and that the two high tension carrying parts and the rectifiers are on the outside, screened off from the grounded motor and metal frame by two large mica discs. This "deep therapy machine" is therefore novel in that it consists of practically two machines connected in series. The difficulties in generating and rectifying high tension current up to 120,000 volts are too well known to require special mention and the creation of voltages over twice as great would therefore seem almost hopeless with the old system. In the new type deep therapy machine, the problem of generating this excessively high voltage of 300,000 volts is therefore simplified by using two transformers of a well-tried-out type, and connecting them in series in the above described manner.

So far as actual results with this method of treatment are concerned, it might be interesting to cite a few points which were reported at the last meeting of the American Roentgen Ray Society, held last September, 1921, in Washington. One doctor,

who had been rather skeptical about this new method, decided to try it out and selected two patients who were in an absolutely hopeless condition, both suffering from cancer in the advanced or third stage. At the risk of causing skin burns, he administered to each of the patients, in one day, what is considered a cancer dose and requested them to return one week later. While very much surprised at their return after that time, his surprise was still greater when he found that one patient, whose cancer was located in the alimentary canal, was able to eat without trouble, while formerly he had great difficulty in swallowing milk, and the second patient, whose cancer was of the pancreas, had gained considerably in weight and showed distinct signs of improvement. Two months later they were pronounced clinically free from symptoms of the original disease and from all external appearances they were cured. Similar cases were reported by many others, and it might be stated that the spirit of that meeting seemed to indicate that this method of attacking malignant cases, if used in the proper way, is the only effective weapon against cancer.

METHODS OF MEASUREMENT

Undoubtedly, a short survey of the methods of measuring *x*-rays used at the present time would be of some interest to engineers. These may be divided into two classes: the direct method and the indirect method. The former is based on the observation of changes produced by the rays in certain substances, such as pastilles which consist of small paper discs covered with bario-platino-cyanide and which turn dark in proportion to the quantity of *x*-rays that fall upon them. Another visible chemical change is produced in mercury iodide pastilles or is recorded on a photographic paper which must be developed under absolutely regulated conditions. These direct methods of measurement give only a very rough approximation of the quantity of rays and are all based on the unverified hypothesis that the action of the rays on these chemical materials is the same as on the living tissue. However, this has never been corroborated, but there is even evidence to the contrary as to the correctness of this assumption. These direct measurements were relied upon in the practical roentgen ray laboratory until the time came when the whole roentgen art advanced to a more scientific stage, when actual measurements upon the *x*-ray generating currents were made. It is now about three or four years since roentgenologists became accustomed to reading the milliampere meter and using the parallel spark gap as a voltage indicator. For the lower voltages used in radiographic work, the point-point gap gives satisfactory readings, but for measuring the higher voltages used in therapy the sphere gap, as standardized by the American Institute of Electrical Engineers, is more reliable.

The instruments used in the scientific laboratory, such as the selenium cell or an ionization chamber for measuring the intensity of *x*-ray radiations, have been used extensively for research, and in Europe by roentgenologists, and quite a number of interesting discoveries have been worked out from the measurements made. But, if these instruments are not used under carefully controlled physical conditions, the errors may be very great. The *x*-ray therapists, however, are making very rapid progress in using such instruments, so that these possible sources of error are gradually being eliminated or minimized.

An exact measurement of the quality and quantity of the rays is certainly very important in this work, especially if we consider the fact that for therapy it is necessary to pass the radiation from the tube through an appropriate filter so as to withhold all rays of lower penetrative power than the principal radiations. This is absolutely necessary, for otherwise, the more active rays of low penetrative power would be stopped in the surface layers of the tissue and would cause skin burns before any effect could be exerted in the deep by the more penetrating rays. It follows that if the less penetrating rays could be eliminated, it would be possible to considerably increase the dose upon the deep-seated part without overdosing the skin layer. Therefore, although filters decrease the intensity of the total radiation quite markedly, they cannot be omitted.

Before *x*-ray treatments can be given safely, it is necessary to:

1. Determine the thickness of filter required to to eliminate from the radiation all rays of lower penetrative power.
2. Measure the intensity of the radiation which passes through the filter.

At the present time it is known that approximately 0.75 mm. of copper or zinc is required to make the rays sufficiently homogeneous for practical purposes, but the exact dosage or the biological effect of the various voltages applied to the tube must be determined for practically every machine. For a given thickness of filter, therefore, a conversion factor must be determined in order to

be able to calculate the dosage from the energy consumed in the tube. This means that a conversion factor expressing the relation between the radiant energy produced by the measured electrical energy passing through the tube and the radiation which emerges through the filter must be determined by actual test. The electrical measurements of the current, and the voltage, i. e., the milliampere meter reading and the spark gap, are therefore recorded, so that the operator is able to reproduce a given tube setting or duplicate the work, but these cannot be depended upon as absolute indices for quantity measurements.

PROSPECTS

A question probably exists in the mind of every one interested in this subject regarding the prospects and expectations for the future of the roentgen therapeutic methods for malignant diseases or for the radiographic method of diagnosing diseases in general. The past war has undoubtedly established the fact that for the diagnosis of diseases, the use of *x*-rays constitutes one of the so-called positive means of diagnosis. While before the war only a few so-called *x*-ray specialists and some of the more modern internists had recognized and believed in the value of *x*-ray diagnosis, many more men while in the service became acquainted with the great advantages of the *x*-rays in diagnosis. A direct evidence of this is the fact that since the war the use of *x*-rays has been increased enormously and is still increasing, especially since clinical experience in this field has also been considerably augmented.

As to the method of treating malignant diseases, it seems that surgery is gradually being displaced, as it does not always bring about a permanent relief from the affliction, for, even if the malignant part is successfully removed, recurrence of the disease sets in almost immediately and the disease then progresses at a far more rapid rate than before the operation. For a long time *x*-ray therapy was employed as a method of after-treatment after surgical procedure, but clinicians are more and more coming to the conclusion that without surgical interference, i. e., with *x*-ray therapy alone, it is easier to cure the disease than after the growths have been removed by surgery. The general trend seems to be more and more toward the use of deeply penetrating *x*-rays for the treatment of malignant diseases and the results obtained seem to indicate that, as the clinical technic advances, *x*-ray treatment will be used more and more extensively.

As to the method of procedure in the treatment of malignant diseases with *x*-ray, there are two theories which are now being tried out. One is to deliver *x*-ray in small doses to the diseased part and in that way inhibit the growth of the disease and stimulate the defensive function of the system. This method is perhaps less difficult to apply and to control, and is less burdensome to the patient. The second theory is to give the patient a full cancer dose in one or two sittings, which may last from 5 to 10 hours, or, in other words, deliver to the cancer a so-called knockout dose. This method seems to gain in reputation and seems to produce very striking results, especially in the more advanced cases, which would otherwise be hopeless. There seems to be great enthusiasm over those cases which are treated with knockout doses, and while it is to be hoped that there may be no mistake about the beneficial results obtained by this method, yet the enthusiasm may be somewhat exaggerated because of the very unexpected results. From the general tone that prevails at roentgen ray meetings, however, the impression is gained that there are enough men in the field with sufficiently conservative judgment to prevent the error of overrating these methods.

Much work is still in store not only for the clinical roentgenologist, but also for the physicist; for the latter, the most serious problem is to study the nature and properties of scattered radiations, and for both, to compare and test the relation between physically obtained data and physiological effects. For the roentgenologist, there remains the problem of working out methods for the treatment of the patient, either before or after the *x*-ray treatment, so that the rays can be applied in sufficient quantity to actually destroy and inhibit the disease. A review of the literature on this subject clearly shows that failures in this method are generally due to inefficient and improper application of the rays and the most serious problem therefore is to outline and determine standard methods or the best conditions under which an effective *x*-ray dose can be administered to a deep-seated lesion without seriously injuring the patient.

In conclusion, I wish to express my desire that in the time allotted me I have been able to bring before you some of the most important problems which confront the *x*-ray engineer. Although the *x*-ray art has made remarkable progress during the short time of its existence, it is my opinion that it will be furthered very materially by formulating

and working out standards in technic and apparatus, so that the methods of applying the rays will be uniform, the results of various investigators can be compared and improved and the therapeutic results can be duplicated at any time and in any place, and may thus become beneficial to mankind.

ARTIFICIAL PNEUMOTHORAX IN PULMONARY TUBERCULOSIS*

EVERETT K. GEER, M.D.
St. Paul, Minn.

Artificial pneumothorax in the treatment of pulmonary tuberculosis has been used extensively in this country only since 1912, although it was recommended a century ago. James Carson[1] of Liverpool in 1821 urged its use on theoretical grounds shortly after the elasticity of the lung was recognized. In 1832 James Houghton[2] and in 1837 Stokes[3] reported cases showing improvement after spontaneous pneumothorax had occurred. Several other citations are found in the literature of the nineteenth century where the chest wall was opened to control hemorrhage.

It was Forlanini[3] of Pavia, Italy, in 1894, who first induced a pneumothorax for therapeutic purposes in chronic phthisis. Quite independently of Forlanini, John B. Murphy[4] of Chicago in 1898 performed the same operation, using a trocar and cannula, and advocated its use for incipient cases, claiming it was the appendix question in a new form. For some time little or no attention was paid this form of treatment until Brauer[5] and others in Germany took it up and reported their first cases in 1905 and 1906. In 1906, Forlanini[3] reported 25 cases which he had treated since his previous publication. In 1912, Robinson and Floyd[6] awakened American interest in pneumothorax therapy.

Since then, induced pneumothorax has been widely used and has assumed its rightful place among the therapeutic measures known to have definite value in the treatment of pulmonary tuberculosis.

The primary purpose of artificial pneumothorax is to collapse the lung as completely as is possible, thereby putting it to rest, thus satisfying one of the cardinal requisites in the treatment of tuberculosis in nearly all parts of the body. When one stops to reflect that the lung is constantly in motion, expiration and inspiration occurring about 20,000 times a day, the immense importance and value in putting the lung at rest is readily understood and appreciated. Benefits of importance other than rest ensue upon lung compression. As the lung is collapsed, it becomes emptied of its contents. The bronchioles, alveoli and cavities, if such exist, are rid of pus, cellular débris and inflammatory exudate; in a sense, drainage is effected. By the reduction in volume of the lung, atelectasis is produced which favors fibrous tissue formation,[7] and therefore healing. Post-mortem evidence leads us to believe that no fresh tubercles develop in the collapsed lung.[3, 8]

Another factor of interest and importance to the clinician and patient alike, is the rapid reduction of toxic symptoms. Fever subsides, night sweats cease, malaise disappears, wasting is checked; the patient begins to feel better, his expression is brighter, he takes a new lease on life. This barring or damming up of the toxins is accomplished presumably by the lymph stasis, which results from the lung immobilization. The lymph stasis reduces absorption to a minimum and breaks the vicious circle of autotoxemia-focal reaction-autotoxemia, which is dragging the patient mercilessly down. Although there is a definite checking of the lymph circulation, the blood flow seems to be but slightly impaired.[9] At times we are unable to obtain a complete collapse because of adhesions, but frequently in these partial collapse cases, the compression is sufficient to reduce the toxemia to a point where the natural resistance is given an opportunity to pick up, thereby starting the patient on the up grade.

To no small degree, the success of pneumothorax treatment lies in the selection of cases for its application. In severe ungovernable hemorrhage, when the origin of the hemorrhage can be ascertained, pneumothorax is indicated; large amounts of gas (1000-2000 c.c.) are used in these cases to collapse the lung immediately in order to check the bleeding.

In early and moderately advanced disease, with persistent recurrence of small hemorrhages, pneumothorax is most efficacious.

The classical case for artificial pneumothorax is the one of advanced unilateral disease. Advanced disease, strictly limited to one side, is rather unusual, as we learned after the advent of the *x*-ray. It occurs in probably not more than 5 per cent of advanced cases. Evidence of involvement in the supposedly sound lung has been stressed as a con-

*Read before the Medical Forum and Ramsey County Medical Society, December, 1921.

traindication to collapsing the extensively involved one by many workers, particularly in Europe, but experience in recent years has shown that this contraindication is far from absolute. Kendall,[10] in a series of 131 cases, had 71 per cent with bilateral involvement. Simon[11] and others have shown that in bilateral cases the collapsed lung frequently shows marked improvement. We have noticed this in four of our cases. Therefore, bilateral involvement does not necessarily contraindicate pneumothorax, but it probably renders a less favorable prognosis.

There have been advocates for the induction of pneumothorax in the early stages, but it seems to us that these patients should be given a trial under a strict sanatorium regime and if they improve let them so continue.

In event of the disease progressing, despite careful sanatorium treatment, we feel that compression should be instituted even though the lesion be not extensive. This is a point not sufficiently emphasized in the literature, though several workers have taken the stand. Unfortunately, many are inclined to wait too long and to use pneumothorax as a last chance. Beggs[12] very aptly has said, "In tuberculosis, to wait for a last chance is to wait for a lost chance," and that "there are as many consumptives who die as a result of neglected opportunities as from any other cause." Perhaps this is an exaggeration, but the point is well taken. Too often cases are permitted to go until extreme emaciation has occurred and all resistance gone before compression is considered. It is as unfair to judge the efficacy of pneumothorax therapy in this class of cases, where results are bound to be unfavorable, as to judge surgery in its attempt to deal with malignancies which have metastasized. Balboni[13] goes straight to the crux of the matter in asserting that, "No case, so long as it is progressive in character, can be regarded as too early for pneumothorax treatment."

Certain conditions besides active bilateral phthisis may contraindicate the induction of pneumothorax—emphysema and asthma, heart lesions, nephritis and intestinal tuberculosis. Several authorities[3, 10, 14] cite diabetes as a contraindication to the induction of pneumothorax. We have had two such cases in which no untoward events occurred which could be ascribed to the diabetes; both of them were under good control, being sugar-free.

The technique of inducing pneumothorax is quite simple, but not entirely without danger. Gas is to be introduced into the pleural cavity and that cavity only. Several types of technique have been described, but we employ that generally used in doing a thoracentesis. The skin is iodinized; 1 per cent novocaine used subcutaneously and down to the pleura; the skin incised with a sharp-pointed bistoury and the pneumothorax needle inserted.

The apparatus used is not complicated. The Robinson outfit consists primarily of two large bottles of 2000 c.c. capacity each and a U-shaped tube graduated in centimeters, called the manometer, which is the most important part of the equipment, as it tells us whether or not the needle is in the pleural cavity. The two bottles are connected with each other by rubber tubing, and one bottle connects with the manometer by a Y-piece, the third limb of the Y carrying the needle. To prepare the apparatus for use, bottle "A" is filled with water, a sterile cotton filter is attached and, by creating syphonage, bottle "B" fills with the water which has been displaced by filtered air in "A." Nitrogen was used for some years, presumably because it would be absorbed more slowly than oxygen or air. It has been demonstrated quite conclusively, however, that there is very little difference in the rate of absorption by the pleura between nitrogen and air.[15] Air, being omnipresent and inexpensive, is quite universally used at present. A specially constructed needle is used; the one devised by Floyd we have found to be very satisfactory.

The first injection of gas should be done with extreme care, as it is at this time that accidents are prone to occur. The site where the needle is first introduced is usually in the sixth, seventh or eighth interspace between the axillary and posterior axillary line, as here the excursion of the lung is the greatest and hence adhesions are least likely to be present.

Adhesions are the greatest bar to a successful collapse, but we are learning to deal with them satisfactorily. In favorable cases, where the adhesions are not massive, it is possible to separate them with the actual cautery through a thoracoscope. Jacobeus,[16] who first suggested this procedure in 1913, has recently reported 40 cases in which it has been done with good results in 75 per cent. He reports no serious hemorrhage in any of these cases. Although numerous methods have been propounded to detect the presence of adhesions, the most reliable way is to introduce the needle and note the manometric response.

The patient should be in the recumbent position, with the hand of the side to be punctured placed over his head, to widen the intercostal spaces. It is well to give a sixth of a grain of morphine just before the first inflation, to quiet apprehensiveness. The patient having been prepared as outlined above, the needle is inserted in the small skin incision and pushed slowly but firmly down at right angles to the chest wall. On reaching the endothoracic fascia, one encounters a firm resistance. This is repeated on passing through the pleura. Once in the free pleural space, the manometer gives an unmistakable reading of from —3 to —6 or —7, the column of water fluctuating with inspiration and expiration. The gas can now safely be introduced, 300 c.c. being the average first fill. This amount of gas will produce no appreciable effect upon the intrapleural pressure, as registered by the manometer, if there are no pleural adhesions present. If a small pocket has been entered, the pressure will rise markedly. If there are dense adhesions, with no pleural space, the manometer gives little or no response, and, if this be the case, no gas should be introduced. If the needle goes through into the parenchyma of the lung, no change is recorded, and if into a bronchus or bronchiole, usually slight oscillations equal on the two sides are noted.

If fortune has been with the operator and he finds a free pleural space, gas should be introduced every third or fourth day, 400 or 500 c.c. at a time till the lung is collapsed. Shortle[17] has emphasized the importance of giving small amounts of gas and not waiting too long between refills. He says, "With small frequently repeated doses, the lung is slowly collapsed, giving time for the other lung to develop its compensating emphysema, and then when collapse is effected it is maintained instead of the lung being allowed to partially re-expand and thus break up what granulations have formed." The degree of collapse is determined most accurately by the *x*-ray. The intrapleural pressure rises with each refill, care being used to obtain the optimum pressure necessary to collapse the lung rather than the maximum pressure which the individual can tolerate. If we produce too great a pressure, the mediastinum is pushed over too far, effecting a partial compression of the functioning lung, inducing dyspnea, cardiac embarrassment and perhaps pulmonary edema. Parfitt[18] calls attention to the necessity of more closely watching the manometer and of more carefully interpreting the readings. He stresses the fact that the mediastinum is a mobile structure and harm to the patient will result if this fact is neglected and high pressures used promiscuously. At first, the pleural surface absorbs the air rather rapidly, necessitating frequent refills, but as time goes on this power of absorption diminishes so that at the end of six months or so a refill every two or three weeks is sufficient to maintain a good collapse.

If we have had the classical case suitable to pneumothorax treatment, i.e., the unilateral progressive type, and have found a pleural cavity comparatively free from adhesions, the results from the compression are striking. The fever subsides not to return, barring complications. As the lung is being collapsed, the amount of sputum naturally increases, due to the squeezing-out process, but with a complete collapse attained, the expectoration drops to a very small amount and usually ceases. Night sweats disappear with the re-establishment of normal temperature, affording the patient untold relief; his appetite improves and he begins to feel stronger.

The physical signs obtained as the lung is gradually collapsed are such as would be expected. With the repeated introduction of air, the mobility of the side is greatly diminished, the percussion note becomes hyperresonant and the breath sounds become fainter and fainter, finally absent, the adventitious sounds disappearing with the breath sounds. Occasionally, we hear exquisite amphoric breathing or distant metallic breath sounds where the lung is completely collapsed. These are due to sounds from the bronchi.

Unfortunately, all pneumothorax cases do not follow the ideal path as outlined above. There are dangers attendant upon the operation itself as well as complications which may follow it. Pleural shock, gas embolism, perforation and rupture of the lung and subcutaneous emphysema, constitute the chief dangers, while pleural effusion is the main complication.

Pleural shock is infrequent and varies in degree from an increase in pulse rate, accompanied by pallor and dyspnea, passing off in a few minutes, to an alarming state approaching death. Its etiology is obscure and the best preventive is the thorough injection of novocaine.

Capps and Lewis'[19] work with dogs tends to throw some light on the question of pleural shock. They found that irritation of pleuræ of healthy dogs produced little or no effect upon blood-pressure. In dogs with artificially induced pleurisy, irritation of the visceral pleura by means of a sharp

needle or chemicals in some instances caused no disturbance, in others it induced a marked fall in blood-pressure. They were able to distinguish two types of depressor reaction:

I. Cardio-inhibitory. These exhibited slowing of the heart action, violent excursion of the diaphragm in the tracings and slow respiration. This type of reaction was checked by vagus section or atropine.

II. Vasomotor. Here was noted a rapid thready pulse and a steady fall in blood-pressure that not infrequently terminated fatally. Adrenalin intravenously combated this type effectually in several instances. It is quite probable that the syndrome known as "pleural shock" is closely related to "depressor reactions" observed in dogs, although it must be borne in mind that it is probably injury to the parietal pleura which produces the symptoms in man, whereas the visceral pleura was irritated in the dogs. We have not met with pleural shock in over 500 punctures.

Gas embolism occurs when proper attention is not paid to the manometer and the air turned on when the needle is in the lumen of a blood vessel instead of in the pleural cavity. At times, gas embolism is difficult to differentiate from pleural shock so closely one may simulate the other. Collapse, respiratory irregularity, thready pulse, dizziness, pupillary inequality, and hemiplegia are the symptoms usually noted. Gas bubbles in the retinal vessels are claimed to have been seen, but this is uncommon. At times, rarely, death occurs with no warning. Since Saugman introduced the manometer in 1907, gas embolism fortunately has been practically obviated and relegated to the early period of collapse therapy.

Perforation of the lung with subsequent spontaneous pneumothorax is not common with the specially constructed pneumothorax needle. Besides the shock usually attendant upon the occurrence of spontaneous pneumothorax there is the added danger of a pyothorax. Rupture of the lung by the separation of an adhesion at its visceral attachment or by the blowing out of a subpleural cavity is a grave complication. This adds a spontaneous pneumothorax to the induced one with its attendant shock and danger of infection. We have had two such cases, one dying within 48 hours, the other within a month of the accident.

Subcutaneous emphysema is not particularly dangerous, but may be painful if extensive. It usually occurs if the patient coughs severely after the gas has been given and the needle withdrawn. Rarely the gas works its way under the costal pleura and up the trachea to the neck, where crepitations can be felt. Dysphagia may result if the emphysema be severe enough. The outcome is always favorable. Kessel and Taschman[20] consider subcutaneous emphysema a contraindication to reinflations. Our experience does not substantiate this view.

Pleural effusion (serous) occurs in approximately 50 per cent of all pneumothorax cases, according to most workers. In our very limited experience of 21 pneumothorax cases, effusion has developed in eighteen, some slight and appreciated only by the fluoroscope, others easily discovered by physical examination. Peters[21] also has found fluid in 90-100 per cent of his cases. With the exception of a small number of cases with pyogenic infections, due to faulty technique, the effusions are sterile to ordinary culture and show tubercle bacilli microscopically or in guinea pigs. Various theories of explanations have been advanced to explain this frequency of effusions. Klemperer's[22] explanation is that "disease processes which reach the surface of the lung and the visceral pleura cause adhesions in patients with normally superimposed pleural sheets, but in pneumothorax with separated pleural sheets exudative inflammations are the result." Bullock and Twitchell,[23] on the other hand, consider the effusion a response to a foreign body irritation, the gas acting as a foreign body. Paterson[24] considers them all of inflammatory origin.

The mode of onset of these pleurisies is not always the same. In some, the fluid may form slowly with no symptoms. These patients usually note the "splash" themselves before the physician detects it. In others, the onset may be sudden and acute, with pain, high fever and general illness, followed by the more rapid appearance of fluid.

As a rule, it is better not to withdraw the fluid unless it causes cardiac embarrassment, because it keeps the lung collapsed and tends to absorb spontaneously. Then, too, an immunizing effect may result from the effusion. If fluid is withdrawn, gas should be introduced simultaneously or directly after to maintain compression.

Unfavorable effects may follow an effusion. If there is fever with general symptoms, the setback may be made up with difficulty. An effusion also tends to a thickening of the visceral pleura, which,

of course, would hinder the ultimate expansion of the collapsed lung. A true pleuritis deformans may follow an effusion. This results from the obliteration of the pneumothorax cavity, due to the pressure of the contracting fibrous tissue in the organized pleural layers. There is a very gradual contraction of the side, and drawing in of the mediastinum which the highest gas pressure cannot prevent. Not infrequently the collapsed lung is partially re-expanded with a subsequent reappearance of symptoms.

Occasionally, the serous fluid becomes purulent, containing many tubercle bacilli, but no pyogenic organisms. Some of these pyothoraces clear up under repeated aspiration with gas replacement; others persist for some time with no apparent harm to the patient, while still another group go downhill slowly, despite any and all treatment. Kalb[25] has recently reported success in these tuberculous empyemata by using the Murphy treatment of aspiration and replacement with a two per cent solution of formaldehyde in glycerine, using about half as much of this solution as pus aspirated. He cleared up seven of ten cases by this method. Rib resection and drainage has been notoriously unsuccessful with uncomplicated tuberculous empyemata.

The length of treatment cannot be determined with accuracy because we have no means at our disposal to tell when the disease is healed. Most authors agree that the collapse should be maintained for at least two years, and, even at the end of that time, the expanding lung should be followed most carefully so that reinflation can be instituted in case fever, cough, etc., make their reappearance. Shortle[17] makes an excellent point concerning the re-expansion of the compressed lung. Instead of abruptly discontinuing refills, he gives smaller and smaller inflations, which permits the lung to come out more slowly, which is obviously a very wise procedure. Some patients require a pneumothorax for an indefinite period, whereas cured cases are on record following only one year's collapse. In doubtful cases, it is better to continue treatment than to stop it.

The general care of collapse cases must not be neglected. From some over-enthusiastic articles, one is apt to deduce that with the lung collapsed the problem is solved. This is far from the truth. These patients still need careful watching and a well-supervised regime mapped out for them. We generally keep them in bed for at least one month after their temperature has become normal, then gradually permit them to go to the table for meals and finally start them on exercise. In other words, they undergo the usual sanatorium regime, and it is exceedingly important that this be done.

In speaking of the general results of pneumothorax treatment, Riviere,[3] in 1917, said, "that the time for a statistical summing up of the results of pneumothorax treatment has hardly yet arrived. Nevertheless, though the ultimate percentage of complete cures is hardly yet at hand, the enormous volume of clinical improvement clearly emerges from the available figures, and even if the results were not permanent, yet the prolongation of life, increased comfort and well being, and return of power to work, and this, for the most part among cases of advanced disease, entitles the operation of pneumothorax to a very high place among successful therapeutic measures." Sewall[26] recently has deplored the fact that the literature is nearly silent on the final results of pneumothorax treatment. Saugman,[27] however, has given results which seem final enough, covering over 400 cases which had been discharged from 1906 to 1916. His report gives their condition in January, 1919, which shows that 32 per cent of those in whom collapse was attained were capable of doing light or ordinary work. Remembering that his results cover a period of 10 years and that his patients were severely attacked third-stage patients, whose prognosis was otherwise hopeless, one must admit that in pneumothorax therapy, we have an efficient well-proved method of treatment.

Our experience during the past two and a half years, covering 21 cases, substantiates previous reports on the efficacy of collapse therapy. We have had indifferent results, to be sure, but we have also had brilliant success. It is too soon to give anywhere near final results on our series, but we are convinced by our short experience with the procedure that it has definitely positive value in the treatment of pulmonary tuberculosis, that its possibilities should be kept more in mind by the profession at large and that patients should be given the opportunity that pneumothorax offers them, not as a last chance, but before their resistance is beyond recall.

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REPAIR OF PERIPHERAL NERVES*

BENJAMIN F. DAVIS, Ph.D., M.D.
Academy of Clinical Medicine
Duluth, Minnesota

With the experience of the war as a background, we now harbor no doubt as to the process of regeneration in peripheral nerves. Given a freshly sutured nerve, we know, as observed by Ranson,[1] that within the first twenty-four hours there is formed a plastic exudate between the nerve ends. In the distal stump, adjacent to this exudate, is a narrow area in which evidences of an early abortive renegeration are seen, characterized by the formation of many small branches from the axis cylinders, having club-shaped end bulbs. These form a distinct network. Distal to this, degeneration of both medullated and nonmedullated fibers begins at once and progresses rapidly. By the eighth day the neurilemma cells have increased greatly in size and have formed protoplasmic bands which largely fill the space formerly occupied by the myelin and axis cylinders. In the proximal stump, a narrow area adjacent to the exudate shows an abortive regeneration similar to that in the distal stump. For a short distance proximal to this is a form of reaction characterized by swelling of the nerve fibers and the formation of a neurofibrillar reticulum which fills up the space within the neurilemma. The axis cylinders undergo retrograde degeneration up to 5 to 10 mm. above the suture line. The new fibers are seen on the eighth day as side branches coming off above the zone of degeneration, multiplying rapidly and growing downward as parallel bundles within the neurilemma, or spirally to form distinct skeins. When the scar is reached, these new fibers, with their terminal bulbs, spread in all directions, forming a dense network, the general trend of which is toward the distal stump. By the 14th day, a large number of new fibers have bridged the scar and started to grow into the distal stump, where they are guided by the protoplasmic bands in which they travel. Kirk and Lewis[2] observed similar phenomena after tubulizing with fascia a gap formed by removal of a 10 mm. segment of the sciatic nerve in dogs. They demonstrated that the protoplasmic bands which form, bridge the gap within six days and that the regenerated neuraxes from the proximal stump penetrate the distal segment within three weeks.

*Read before the Interurban Academy of Medicine, January 18, 1922.

Huber[3] has called attention to the importance of the nerve pattern; this he has likened to a conduit system, each tube of the system leading to some definite point. In the nerve, the fibrous framework, of which the endoneurium represents the finest subdivisions, represents the conduit, and the contained neuraxone, with its myelin sheath and enveloping neurilemma, the insulated electric wire. In the regeneration of nerve fibers, the protoplasmic bands, formed by the proliferating neurilemma cells supported by the endoneurium, are comparable to the empty tubes of a conduit system, some leading to motor end-plates, some to sensory end-organs. If the distal segment of the nerve were rotated so that the patterns of the distal and proximal segments no longer coincided, then motor nerves might find their way down sensory pathways and sensory nerves might find their way to motor organs and thus be as effectually lost from the functional standpoint as though they had never been regenerated.

Miller[4] has recently correlated the microscopic changes in the process of nerve regeneration with the gross changes and with the restoration of the tensile strength of the nerve at the point of suture. He summarizes his findings as follows:

"At the end of the first week after suture, the plastic exudate is beginning to organize. There is degeneration of axis cylinders and medullary sheaths in the area immediately adjacent to the exudate; protoplasmic bands have partly bridged the gap, but the new neuraxes have not as yet penetrated the scar. The weight necessary to separate the two segments at this stage falls below 1,000 gm., the average for nerves of different diameters being 574 gm.

"After two weeks: At the end of the second week, a marked change has occurred. The exudate has become a well organized scar, which has increased the diameter of the nerve about 2 mm. Degeneration in the proximal stump has ceased, and the new neuraxes have not only entered the scar but have formed a dense network there. A few have even penetrated the distal segment. The strength of the suture line has increased enormously. A very small nerve (1.5-2 mm. diameter) now supports 1,665 gm.; a medium sized nerve (3-4 mm.) on an average, 4,271 gm.; and a large 5 mm. nerve, 4,471 gm.

"After three weeks: The change in tensile strength is less marked. Practically all the new neuraxes have entered the distal segment and have begun their downward growth within the protoplasmic bands. The strength of the suture line at this period, though not much greater than at the end of two weeks, is becoming more directly proportional to the diameter of the nerve, and the line of separation, instead of always being a clean-cut transverse break, is frayed and irregular. The silk stitches have now become less of a factor than in the earlier days. As a rule they can be readily picked off the surface of the scar with forceps.

"After four weeks: We should expect from the histology of the changes which have occurred at this time to find the suture line very strong, inasmuch as the scar is completely healed, and made up of cable-like bundles of new, well developed fibers surrounded by organized connective tissue. On Dog 46, a husky animal, a bilateral suture of the sciatic nerve was performed. The right sciatic nerve supported 9,202 gm., while the left nerve broke, not at the suture line, but where the forceps were attached.

"After five weeks: The process of repair is complete. The strength of the suture line has now become as great as we should expect it to be even at the end of the sixth, seventh or eighth week. Actually there has been little change in the tensile strength for the past two weeks, but the direct ratio between the size of the nerve and its strength at the suture line has become better established."

To summarize the process of nerve regeneration, we may say that the neuraxes arise from intact proximal nerve fibrillæ and cross the suture line peripheralward in protoplasmic bands, which arise by proliferation of the cells of the neurilemma, which bridge the gap and replace the original nerve trunk. The point of nerve section, if adequately sutured, is bridged and practically restored to normal within four weeks.

TECHNIQUE OF OPERATIVE REPAIR

Before the war there were many methods for the repair of peripheral nerves by operative measures, most of them faulty and yielding very poor results. At present there are but three surgical methods which are at all worthy of consideration, namely: end-to-end suture; the so-called cable-graft, and the fascial tube.

Of these, the first is by all means of greatest importance; the other two should be used only when end-to-end suture cannot be obtained. In performing the operation of end-to-end suture, it is essential to permit the ends of the nerve to come into actual contact without undue tension. In many instances, this may be done without trouble. Many times, however, the gap to be bridged will make it impossible to approximate the nerve ends without resorting to other measures. There are in general four aids which we may employ.

First, mobilization. For this purpose, a long incision is made in the course of the nerve and the nerve is dissected free from all attachments. Much more may be gained in this manner than by attempting to stretch the nerve without first dissecting it free.

Second, transposition. By this, we mean changing the course of the nerve, as, for instance, transposing the ulnar from the posterior to the anterior

side of the elbow joint, thus lessening the distance which it must cover.

Third and Fourth, flexion of joints and adduction of limbs. For instance, in the case of suture of the sciatic, by flexing the knee, two to four additional inches of nerve may be mobilized, and in the case of the musculospiral, by adduction of the arm 0.5 to 2 cm. may be gained.

A fifth method may also be of great assistance. In case none of the four above mentioned suffices, it is wise at times to suture the fibrous ends of the divided nerve as near together as may be, with the limb strongly flexed, and then by gradually extending the limb, in the course of several weeks, so stretch the nerve that upon secondary operation it may be possible to resect the scar tissue and obtain direct end-to-end suture. Some surgeons have practiced resection of segments of bone in order to shorten the limb and thus permit approximation of severed nerve trunks. This measure must be very rarely indicated, and is here mentioned largely for its historical interest.

Adopting the methods of securing end-to-end suture just enumerated, Naffziger[5] considers the following figures to represent the average of distances which may be bridged:

For the ulnar nerve: mobilization alone—3 cm., mobilization and transposition—4.5 cm. Adduction of the arm permits a slight additional gain and mobilization, transposition, adduction, and complete flexion of elbow and wrist, 10 cm.

Musculospiral: mobilization—2 cm., with elbow flexion, 8 cm., adduction adds .5 cm., mobilization, elbow flexion, transposition and adduction—10 cm.

Median: mobilization—2 cm., mobilization, adduction and elbow flexion, 9 cm.

Sciatic, internal and external popliteal trunks: mobilization—3 cm.; mobilization, extension at the hip and flexion at the knee, 9.5 to 10 cm.

These figures represent distances which may be bridged at one-stage operations. With two-stage performances, additional gains may be made. Naffziger also stresses the importance of preserving the nerve pattern during these maneuvers so that sensory nerves may not grow down motor pathways.

When sufficient length of nerve trunk has been secured, the ends of the nerve segments should be cut off above any infiltrating scar tissue and gently approximated. As suture material, either fine waxed silk or fine plain catgut may be used. In large nerves it may be permissible to pass one or two sutures directly through the nerve trunk. Otherwise, the sutures are passed through the epineurium. It is important that the nerve ends be not jammed together too tightly by the suture, as this may tend to curl the ends up or crush them, thus disturbing the nerve pattern and throwing out a barrier in the pathway of the down-growing neuraxes.

The cable-graft method consists in sewing into the gap between the nerve ends segments of some sensory nerve. As the sensory nerves chosen are usually less in diameter than the nerve which is to be repaired, one may actually make a cable of the sensory nerve by implanting 3 or 4 or more segments side by side in the space to be bridged, these segments of nerve being regarded exactly as segments of a conduit system. The objections to this method are that it requires at least two incisions; one to expose the nerve to be repaired, and the other to expose the nerve to be transplanted; it involves the formation of two suture lines, and, as has been pointed out by Lewis,[6] the distal suture line may cicatrize and block the down-growing neuraxes after they have successfully passed the first suture line, necessitating a second operation with resection of the obstructing cicatrix and resuture; it involves the complete cutting away of tissues from one part of the body and their transplantation to another part entirely removed from their blood supply, so that the tendency to necrosis and therefore disappearance of the transplanted tissue is great.

The fascial tube will rarely be necessary, in view of the two methods just discussed. Its great objection is that, if the space to be bridged is relatively short, the fascial tube will not be needed, while if the distance is too great to be bridged by any other method, it will probably be so great that the fascial tube would become transformed into dense scar tissue before the regenerating nerve tissue could transverse its entire length. At best, it is a measure fraught with great uncertainty.

Following a technically successful nerve suture, how long may we wait before pronouncing it a failure? If signs of returning function do not appear in from three to six months, it is wise to make a second operation and examine the condition of the nerve at the point of suture. This is recommended for the following reason: Muscles which remain inactive through the loss of their normal nerve supply for prolonged periods are very prone to atrophy to such an extent that even though the normal nerve impulse is eventually re-established, the

muscle is no longer capable of functional activity or of regeneration. We now have at our command methods by which we can determine at a second operation whether or not neuraxes have crossed the line of suture and are growing down the distal segment. If, upon exposing such a nerve, we discover that its continuity is interrupted by contracting scar tissue or some other pathological condition at the line of suture, we can resect the affected portion and perform a new suture with good prospects of success and thus avoid the long period of disability formerly recommended. In determining whether or not the neuraxes have crossed the suture line, use is made of the fact, emphasized by Malone,[7] that stimulation of intact sensory or mixed nerves causes reflex stimulation of respiration. If upon exposing the nerve trunk which has been sutured some months previously and applying a threshold stimulus, 2 cm. or more distal to the suture line, we get no effect upon respiration, it is conclusive evidence that regeneration beyond the line of suture has not occurred and resection of the scar with resuture is then indicated. If, however, reflex respiratory stimulation appears we know that nerve fibers have crossed the suture line and are on their way down the new nerve trunk. This test is of no service in a motor nerve, such as the facial, but is applicable to any sensory or mixed nerve.

Failure in nerve suture may be due to cicatrization, to improper technique, to hemorrhage and cyst formation.

Cicatrices may result from involvement of the suture line in adjacent scar tissue and, in several cases, have resulted from replacement fibrosis of the strips of fat and fascia which had been wrapped around the suture line. To prevent scar tissue formation, it is probably better to refrain from using the fat and fascia strip and to endeavor to place the sutured nerve in normal tissues, preferably in an intermuscular plane.

Under the heading of "Improper Technique," we would consider the twisting of nerves, thus disturbing the nerve pattern; too tight suturing, thus crushing the nerve, disturbing the nerve pattern, and folding the nerve on itself; subjecting the suture line to excessive tension, so that the nerve ends are pulled apart, permitting interposition of scar tissue.

Hemorrhage and cyst formation—the latter probably is secondary to the former. Hemorrhage occurs between the sutured ends, the resultant blood clot may be entirely absorbed, it may be replaced by scar tissue, or, if large, it may be encapsulated by connective tissue; under the latter circumstance, the center of the clot may be gradually digested and replaced by liquid, thus forming a cyst.

Under any of the above circumstances, a secondary operation with excision of the faulty suture line and resuture is indicated. It sometimes happens that a portion only of the diameter of the nerve is involved in these changes, the remainder of the nerve being intact; in these cases it is probably wise to conserve the uninvolved portion by making the so-called partial resection and suture. In this procedure, the nerve is cut transversely only to the depth of the scar, the scar is excised, and the nerve ends mobilized by splitting the nerve trunk longitudinally at the level of the depths of the excision so that the normal portion of the nerve may freely loop on itself when the whole trunk is shortened by the approximation of the nerve ends.

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RECTAL APPROACH TO PELVIC ABSCESS COMPLICATING ACUTE APPENDICITIS*

JAMES A. EVANS, A.B., M.D.
La Crosse, Wis.

Rectal approach is often the operation of choice in evacuating a large pelvic abscess complicating acute appendicitis, especially in young children coming to the surgeon in extremis and presenting a large fluctuant mass bulging on the anterior rectal wall. Also, it is often the wisest course in postoperative ruptured appendix cases in which drainage has been inadequate and a pelvic abscess has formed.

Our cases reported here are all of the first group and came to us in such desperate shape that an

*From the Clinic of Drs. Evans and Bannen, La Crosse, Wis.

immediate appendectomy seemed only to lessen chances for survival. A case of the second group ought never to occur. In several hundred appendectomies, we have never found a rectal incision necessary for secondary postoperative pelvic abscess, cigarette and tube drain through a stab in the side with one tube deep in the cul-de-sac having invariably proved adequate drainage in our experience.

Eliot and Pickardt,[1] in ten years' experience, had no secondary postoperative abscesses. They claim invariably adequate drainage using tube and gauze the first thirty-six hours, after which the drains are removed, and a soft Nelaton catheter introduced into the sinus daily, beginning irrigation on the fourth day. Healing of the sinus is thus hastened to twenty days and they claim for their drainage the preclusion of the necessity of later rectal or vaginal drainage for formation of pelvic abscess.

MacLaren[2] has greatly lessened the incidence of secondary postoperative abscess formation by Van Buren Knotts' suggestion. Immediately after the removal of the appendix he makes a secondary stab wound just above the pubes and inserts two large-sized rubber tubes to the bottom of the recto-vesicle peritoneal pouch. However, he claims there will still be a few cases necessitating rectal puncture in order to save. He lays stress on the cases in the first group, those requiring primary rectal incision, cases reaching the surgeon exhausted with a large abscess filling the pelvis, usually in children.

Symptomatology. — Bosch-Arana[3] attributes the abscess to an appendix in close proximity to the pouch of Douglas or a lymphangitis of appendicular origin. The symptoms suggest renal colic or acute colitis. Four cardinal symptoms are named: (1) hypogastric pain; (2) painful polyuria; (3) pain in lumbar region; (4) intestinal colic, with frequent desire to defecate.

We have always found one or more of these four symptoms present. While the histories as quoted below do not always record this point, our impression has been that there is nearly always present a severe tenesmus with the passage of slime.

Operation.—Bosch-Arana[3] makes an exploratory incision, then opens the abscess by a horizontal incision, thus avoiding the hemorrhoidal arteries. Two tubes are inserted, one for injecting antiseptic solutions and one for expelling, and the abscess is irrigated two or three times daily. He prefers this approach both for preoperative and postoperative secondary pelvic abscesses in both male and female, claiming no reinfection of the abscess cavity from the rectum, practically no operative mortality, and a shortening of the convalescence by twenty to thirty days over the suprapubic route.

Our own operation is simpler. Usually no retractor or speculum is needed. Under gas anesthesia or no anesthesia at all, one merely guides a sharp-pointed scissors on the index finger through the rectum and thrusts it into the abscess cavity. The finger enters the cavity, explores, and on the finger as a guide a tube is easily inserted. This tube is left in rarely longer than twenty-four to forty-eight hours. However, after its removal, it is well to examine the rectum daily to see that the sinus remains open until the cavity is obliterated.

Discussion.—Our cases were all in the first group mentioned above: primary operation in very sick children. In eight years' time, out of many cases of acute appendicitis with abscess, there were only ten cases which justified this procedure. The last case, given below for the interest attached, proved later to be tuberculous peritonitis. Six were male and four female. Ages ranged from four to twenty-four; fifty per cent of them were between the ages of eleven and twelve.

In a few selected cases, rectal incision is undoubtedly the safest and least shock-producing of any method of drainage. Even in females, too, especially in young girls, we prefer rectal to vaginal approach. The drainage is perfect; there is no danger of reinfection of the abscess cavity from the rectum; the cavity closes very quickly.

It is often astonishing to see how rapidly a desperate case rallies after this method of drainage (witness Case 12584). For the later removal of the appendix, one is able to approach the appendix earlier and through a clean field, which is rarely the case where one has opened the abdomen. This latter point need not be stressed, however, because rarely does one open the abdomen without being able to remove the appendix.

Usually, from the history, one can tell what patients he will be able to drain in this way, and only those cases that on rectal examination present a bulging, rather tense mass, is it safe to thus open. We have, not rarely, waited more than a day, just as we do in pelvic infection in females before making a vaginal cul-de-sac incision. Indeed, we have

[1] Eliot and Pickardt: Ann. of Surg., lxxiv, 43, p. 430.
[2] MacLaren, A.: Journal-Lancet, May 1, 1913.
[3] Bosch-Arana, G.: Semana Med., 1921, xxviii, 569.

seen one case killed by another operator by neglecting to wait and thrusting an instrument into the small intestines though there was a pelvic abscess present.

MacLaren quotes Lincoln Davis of the Massachusetts General Hospital, "These patients must be carefully watched and if the improvement in symptoms is not definite and continuous, they must be opened from above. The method is ideal only for large pelvic abscesses, when the appendix is itself pelvic in position."

Case 12397. Male. Age 24.

Diagnosis: Acute appendicitis (perforated); general peritonitis; pelvic abscess.

Pain was present in the lower abdomen with vomiting, frequency of urination, pain in the left loin radiating into the left groin, tenesmus, and diarrhea. No fever was present. Outside, the diagnosis was renal colic. When first seen in consultation he presented a Hippocratic facies, dry tongue, generalized abdominal distension and rigidity, with tenderness in the left lower quadrant. Per rectum an abscess could be felt pointing in the cul-de-sac. Temperature 102° (mouth). W. B. C. 18,000.

Under gas the abscess was punctured per rectum but as this did not seem to reduce the mass sufficiently the abdomen was also opened and appendix found ruptured and bowels distended. Two tubes were put in the paretic ileum and the wound was left wide open and copious wet dressing applied. Wicks and gauze were packed into the wound to establish drainage. The patient made a slow but uneventful recovery.

Case 10798. Male. Age 11.

Diagnosis: Acute appendicitis; pelvic abscess.

Nineteen days ago the patient had a generalized abdominal pain with vomiting; pain later localized in lower left side. A few days later he felt better; then the pain returned and vomiting became worse.

On entrance the patient was extremely emaciated, eyes sunken, pulse rapid and weak; the abdomen was distended, tense and tender. Dullness existed over the whole lower abdomen to the umbilicus and on the right almost to the liver. The liver dullness was obliterated by tympany. A round mass was felt per rectum bulging the anterior wall. Temperature 101° (rectal). W. B. C. 32,000.

Under gas the abscess was drained per rectum through a stab wound. A large amount of foul pus was evacuated.

His temperature was normal in two days and the patient sitting up. An uneventful convalescence took place and the patient went home thirteen days after drainage was instituted.

Case 8124. Male. Age 12.

Diagnosis: Acute appendicitis; pelvic abscess; general peritonitis.

One week ago sickness began with a chill, abdominal cramps, nausea, and later fecal vomiting, hematemesis and diarrhea. Constipation persisted after the fourth day despite catharsis and enemas.

The patient showed slight distension and tenderness in the lower abdomen, especially in the lower left quadrant. Rectal examination was negative on entrance. Temperature 101.8° (rectal). W. B. C. 14,000.

Six days later a pelvic abscess was felt per rectum and was opened under gas per rectum. Temperature dropped to normal the next day.

Twenty days later appendectomy was performed. At operation a few adhesions were found at the site of the rectal drainage.

The patient made an uneventful recovery and was discharged three weeks later.

Case 7685. Female. Age 12.

Diagnosis: Acute appendicitis; pelvic abscess.

The patient has suffered from five previous attacks of acute abdominal pain during the past four years.

Eleven days ago a sudden, general abdominal pain with vomiting appeared. Pain and tenderness gradually worked down into the lower left side and later into both lower quadrants. Finally she had pain only when the bladder was distended, and suffered from dysuria and frequency. The bowels were very constipated.

On examination the patient appeared emaciated. Pulse rapid. Temperature 103°. W. B. C. 20,000. The abdomen was slightly distended and generally tender. Under ether, a mass was felt bimanually per rectum extending above the pubes and right Poupart's ligament, half way to the umbilicus. The masses in the abdomen and in the rectum were felt to be continuous.

Under ether the abscess was drained per rectum. The temperature immediately fell to normal.

Nine days later appendectomy was performed in the usual way. The appendix found burst at the tip, with mucosa ulcerated, a few drops of free pus about it, and the omentum adherent to the brim of the pelvis. Convalescence was uneventful.

Case 7263. Male. Age 20.

Diagnosis: Acute appendicitis; pelvic abscess.

Twelve days ago the trouble began with vertigo, vomiting and diarrhea. The next day fleeting, cramping pains appeared in the lower abdomen. Vomiting and pain have persisted and the last two days flatus and tenesmus have been present.

On entrance an indefinite mass was felt in the lower left quadrant, and per rectum a non-fluctuant mass in the pelvis. Patient was put to bed with head elevated and restricted to liquid diet. Enemas were resorted to. In two days' time both the mass per rectum and mass in lower quadrant became larger and distinctly fluctuant. Temperature 101° (rectal). W. B. C. 25,000.

Under gas, abscess was punctured per rectum; about 180 c.c. of foul pus were obtained, but this did not reduce the size of the mass very much. Another extraperitoneal incision was made above the left inguinal ligament and a huge quantity of pus liberated. A thick wall of tissue was then left between the two abscesses. The temperature dropped to normal two days later and uneventful convalescence began.

Case 5952. Male. Age 4.

Diagnosis: Acute appendicitis (perforated); appendiceal abscess; pelvic abscess; measles.

Nine days ago the patient was seized by a sudden pain in the epigastrium, accompanied by vomiting and diarrhea. In a few hours the pain was localized in the right lower

quadrant, gradually abating in severity for the next two days. Constipation and difficulty in starting urination have been present the past few days. Fever has ranged between 100° and 102° for the past week.

The little patient was thin and strained looking. A huge tender fluctuant mass was palpated bimanually per rectum, reaching from the pubes to the umbilicus and filling the lower right quadrant. Temperature 101° (rectal). W. B. C. 27,000.

Under gas the abscess was drained per rectum. The temperature immediately fell to normal.

Ten days later appendectomy was performed in the usual manner and the appendix was found lying adherent and deep in the pelvis. No free pus was found about the appendix, and the bowels were not inflamed except just about it. There was a fecal stone in the mid portion of the appendix with a perforation proximal to it. The appendiceal mucosa was inflamed.

The patient contracted measles during convalescence but was discharged well.

CASE 5014. Female. Age 8.

Diagnosis: Acute appendicitis; pelvic abscess.

This patient was operated on three years ago for perforated appendix, abscess and general peritonitis. Nine days ago she was seized by a sudden abdominal pain, vomiting and headache. The pain was less severe for three days until twelve hours ago, when it again began very severe. Diarrhea persisted five to six times daily with very painful defecation.

Examination showed tenderness over lower abdomen and in pelvis. A large fluctuating mass was felt per rectum impinging on the anterior wall. Temperature 101.5° (mouth). W. B. C. not given.

The abscess was drained per rectum. The temperature fell immediately to normal. The patient was sent home ten days later feeling well, with slight discharge persisting through the open sinus in the rectum.

CASE 12584. Female. Age 4½ years.

Diagnosis: Acute appendicitis (perforated); pelvic abscess.

The onset was sudden with abdominal pain, vomiting, and diarrhea, followed by constipation. Then diarrhea returned, accompanied by marked tenesmus. Retention and dribbling of urine followed.

The abdomen was distended to the umbilicus. Rectal examination revealed a soft fluctuant mass pressing on the anterior rectal wall. Temperature 101.6° (rectal). W. B. C. 22,000.

Under ether, the pelvic abscess was punctured and drained per rectum. Next day the temperature was normal. Six days later there was no discharge per rectum and the patient was dicharged well eight days after drainage.

CASE 13840. Female. Age 11.

Diagnosis: Pelvic abscess (due to throat infection or appendicitis); abdominal abscess (right).

Six days ago the patient developed a sore throat, headache, nausea, and vomiting. Three days later she complained of general abdominal pain, most marked in the lower right quadrant, with great tenderness in the same region. Vomiting became more severe.

The patient appeared very sick, tongue dry, eyes sunken, pulse rapid, and abdomen distended, tense, and tender everywhere, especially in the lower right quadrant. Temperature 103° (rectal). W. B. C. 19,800.

The patient's condition was so critical that she was put on expectant treatment for six days with the head of the bed elevated, Murphy drip, sips of water, morphine, and turpentine stupes. On the fourth day after entrance a mass was palpable above the pubes and right inguinal ligament, and per rectum a bulging was felt above the cul-de-sac. On this day the patient began to have frequent slimy stools and much flatus. She continued to run a high fever and was losing flesh rapidly. W. B. C. 36,000.*

Six days after entrance the pelvic abscess was drained per rectum under gas and much foul pus obtained. This procedure had no effect on the temperature, and vomiting continued. Seven days after operation the mass per rectum had disappeared but a distinct mass was palpable in the right loin. This new abscess was opened under gas and found to extend up under the liver and deep into the loin. The patient died the next day.

CASE 14576. Female. Age 12.

Diagnosis: Acute appendicitis; pelvic abscess; general peritonitus; lobar pneumonia.

No history obtained.

Crackling râles were heard at the lung bases on entrance. The abdomen was slightly distended. General spasm and tenderness of the whole abdomen were present, more marked in the right iliac fossa. Per rectum a mass was felt bi-manually in the pelvis. Temperature 104° (rectal). W. B. C. 14,000.

Under ether this mass was punctured and drained per rectum. With the finger in the abscess cavity, the coils of the intestine could be felt through the abscess wall. A tube was left in the cavity and the wound packed on account of considerable bleeding. Next morning the temperature was normal and the clinical condition improved. Two days later, however, the patient developed a frank lobar pneumonia and died.

CASE 8026. Female. Age 14.

Diagnosis: Tuberculous peritonitis?

This history elicited repeated attacks of pain in the right lower quadrant, nausea, vomiting and fever, with no relation to the menses.

The abdomen was found distended, with tenderness over McBurney's point, and spasticity of the right rectus. Temperature 102° (rectal). W. B. C. 20,000.

Under ether the rectum was dilated and a mass was felt about the size of an orange, behind the uterus. This was punctured and a clear watery fluid escaped. The question was now raised, was this a case of ovarian cyst with twisted pedicle, or of appendicitis with a simple ovarian cyst?

However, the temperature stayed around 102°, the abdomen remained distended, but no masses were palpable and no tenderness was present. The W. B. C. fell to 10,400 three days after rectal puncture. About a month later the temperature was normal but a fluctuant mass was beginning to fill up the abdomen reaching to the umbilicus. This mass was incised and drained and creamy pus of a sweetish

* A white blood count above 35,000, or even 30,000, in peritonitis rather discounts appendicitis as the cause. Suspect a pneumococcal infection. (See Br. Med. Jour., Mar. 4, 1922, page 347.)

odor was evacuated. Two months later the sinus was still discharging slightly but the patient was up and about at home with a normal temperature.

THE RAT AND HUMAN DISEASE

WILLIAM A. RILEY
University of Minnesota
Minneapolis, Minn.

The enormous economic losses due to rats have been considerably emphasized within the past few years. It has been conservatively estimated that the cities of the United States lose $35,000,000 annually from the depredations of these rodents. An equally conservative estimate would place the annual loss for feeding the rats of the Twin Cities at $150,000 without regard to the damage to food and property additional to what was eaten.

A phase of the rat problem which is wholly unappreciated by the general public is that of the relation of this pest to the health of man. Indeed, outside of the localities where there have been outbreaks of bubonic plague, even the physicians of this country take little account of the rat as a factor in the spread of disease. It is the purpose of this paper to call attention to some of the most definite ways in which these rodents may affect the health of man.

In common with a number of other animals, rats may convey pathogenic organisms in two different ways. In the first place, they may serve as purely *accidental carriers*, or, secondly, they may be *natural hosts* of parasites which may be transmissible also to man.

Frequenting privies, drains, garbage heaps and the like, the habits and environment of rats are such that they may readily transfer the germs of various intestinal diseases to the food and drink of man. In a similar way, they may spread ptomaines and various destructive molds and other fungi. Few accurate data regarding this aspect of the problem are available, but it is obvious that simple accidental carriage of contaminations must be reckoned with.

Much more serious are the cases where the rat itself serves as the host of the pathogenic organism, be it bacterial or animal in nature. The method by which the parasite is transmitted to other rats or to man may be either direct or indirect, depending upon the species.

Foremost in importance among the rat diseases transmissible stands the bubonic plague. The common view that this is a disease of warm climates and that northern regions need not concern themselves regarding it has no basis in fact. It is now universally recognized by students of the disease that it causes an epizootic among rats and other rodents and that it spreads to man by the agency of fleas.

Weil's disease, or spirochetal jaundice, is another widespread disease of man which only within the past few years has been definitely traced to rats. The causal organism, *leptospira icterohemorrhagicae* was discovered in 1915 in the urine and kidneys of wild rats in Japan. The findings of the Japanese investigators have been abundantly confirmed by workers in various parts of the world, including the United States. It is believed that the organism escaping in the animal's urine is transmitted to man from contaminated soil, or through food or drink.

A related disease is the so-called "rat-bite fever," or "sodoku," a relapsing fever of long duration which sometimes follows a rat-bite. The causative organism *spiroschaudinnia morsusmuris*, lives in the mouth of the animal.

Rats are subject to certain epidemic diseases which very closely simulate paratyphoid and which are sometimes intentionally spread by the use of various commercial "rat viruses." It has been assumed that the causative organisms were harmless to man, but in recent years evidence has accumulated which indicates that serious sickness and even death of man may be caused by it.

Rosenau (1910) says: "There is practically no difference between the *bacillus typhi murium* and the paratyphoid bacillus, which is the well-known cause of meat poisoning, and the *bacillus enteridion* of Jarbues, which is associated with intestinal disorders."

Both rats and mice are at times affected by a favus which is occasionally transmissible to man, sometimes indirectly through cats which have preyed upon the diseased rodents. Formerly, the causative organism was generally regarded as identical with that of typical favus of man, *achorion schoeneini*, but it is now separated as *achorion quinckeanum*.

Of protozoa, rats and mice not infrequently harbor pathogenic amebâe, which very closely resemble the entamebâe of man. In fact, recent experimental work, notably that of Lynch (1915) and of Brug (1919) have shown that rats may be infected

by the *entameba dysenteriâe* from man and have strongly supported the view that in nature these rodents may be a very definite factor in the spread of these organisms.

Many workers regard the flagellate protozoan parasites *giardia intestinalis (Lamblia)* and *trichomonas intestinalis* of man as identical with species commonly found in rodents. The evidence is especially definite in the case of *giardia*, which is now recognized as a fairly common intestinal parasite of man in this country, as well as elsewhere.

Of the grosser parasites, the rat harbors at least two species of tapeworm which are transmissible to man. Indeed, one of these, the dwarf tapeworm, *hymenolepis nana*, is the most common tapeworm of man in the United States. On account of its small size, 10-15 mm. in length by 0.5-0.7 mm. in breadth, this worm had been very generally overlooked, and had been regarded as a great rarity in man, until the extensive microscopic examinations of stools in connection with hookworm studies.

Hymenolepis nana is almost unique among tapeworms in that it can complete its development in a single host. I have repeatedly verified Grassi's statement that the eggs taken up by a rat develop into a cysticercus in the intestinal villi and that this larval form then transforms into the adult tapeworm in the lumen of the intestine of the same individual host.

A much larger representative of the genus hymenolepis, which is also found in these rodents, is *hymenolepis diminuta*. I have found this tapeworm in 14 per cent of the rats examined in Minneapolis and St. Paul. Moll (1917) reports it in five out of twenty-five examinations at Madison, Wisconsin. This species, like most tapeworms, requires two hosts to complete its development. The intermediate host in this case is any one of several meal-infesting insects, or, very often, the rat flea. Rarely it occurs as a parasite of man, the infection being mostly among infants and children.

A most striking case in St. Paul recently came to my attention. An infant nine months old began to discharge segments of this species of tapeworm. On treatment, several months later, it discharged some twenty-five worms. As a seven-months-old babe, it had been allowed to crawl about in the yard a great deal and had there had opportunity to pick up infected insects which, on their part, had taken up the tapeworm embryos discharged by rats or mice.

It is notorious that rats are the chief carriers of the dangerous trichina. Indeed, it is highly probable that these rodents are the normal host for this nematode. I usually obtain my supply of the parasite for experimental study from rats trapped about slaughter houses. Under such conditions I have sometimes found over 60 per cent of the rats infested.

Stiles, in 1910, wrote regarding trichinosis in man, "This disease will probably never be eradicated from man until rats and mice are practically eradicated, and any rational public-health campaign directed against trichinosis must take the rat into serious consideration. The eradication of rats and mice would be a very substantial contribution toward a reduction and eradication of trichinosis."

Another nematode worm, *syphacia obvelata*, which is closely related to the *oxyuris vermicularis* of man, has been shown recently (Riley, 1919) to be transmissible from rats and mice to man.

Gigantorhynchus moniliformis, one of the thorn-headed worms which inhabits the small intestine of rats and various small mammals, requires a certain beetle *(Blaps)* as intermediate host. The worm has been reported for man, and Calandruccio infected himself experimentally with larval worms taken from the beetle.

As far as is known, there are none of the mites attacking man in this country which are normally parasitic on rodents. The famous "akamushi mite" of Japan, which causes "Japanese river fever," is, to a large extent, dependent upon such hosts.

Obviously, rat fleas attack man, for it is through them that bubonic plague is transmitted from the diseased rodent. Fortunately, infestations of houses in this region are not usually by these species, as they prefer the rat as long as it is alive.

The list here given by no means includes all of the parasites which have been suggested to be identical in man and rodents. It deals primarily with clearly established cases and is sufficient to emphasize the fact that, for reasons of public health as well as for economic reasons, attempts at rat extermination should receive whole-hearted support.

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CASE REPORTS

REPORT OF A CASE OF ABSCESS OF THE TRANSVERSE SINUS WITH HEMOLYTIC STREPTOCOCCEMIA, OPERATION, AND RECOVERY

CHARLES E. CONNOR, M.D.
The Miller Hospital Clinic
St. Paul, Minn.

The patient, a girl eight years old, was first seen on the fourteenth day of May, 1921. Her past history was unimportant. Early in April she became ill with a mild respiratory infection, during which there was slight pain in the left ear for a day or so, but no discharge. Convalescence was uneventful and nothing further was noted until the middle of April, when she again had temperature for a few days and developed a cervical adenitis; there was no ear involvement at this time. On May 1, while the patient was apparently in good health, the left ear began to ache, and four days later a scanty, bloody discharge made its appearance in the canal; the temperature was 103. Paracentesis was done with relief of most of the pain and decrease in temperature; the pain did not, however, completely disappear and the temperature did not return to normal. On May 8, on account of increase in temperature and the appearance of mastoid tenderness, mastoidectomy was done; temperature on the day of operation ranged from 102 to 105.

The first two days after operation were uneventful, the temperature varying from 102.5 to 105. On the evening of the third day the patient experienced a chill lasting about ten minutes, which was followed by a temperature of 105 and a pulse rate of 174; the temperature dropped to 100 in eight hours. On the morning of the fourth day there was another chill, followed by a temperature of 106, a pulse rate of 174, and a respiratory rate of fifty. Normal was reached again in eight hours. On the evening of the same day there was another chill, followed by a temperature of 105.5, a pulse rate of 160, and a respiratory rate of 42. Normal was reached in eight hours. At noon on the fifth day there was a slight chill, lasting perhaps three minutes, followed by a temperature of 105, a pulse rate of 146, and a respiratory rate of 42; normal was not reached for twenty-four hours. Following this last chill, paracentesis was done under gas anesthesia.

The patient was seen in consultation on the evening of the fifth postoperative day. She appeared acutely ill. The face was flushed, the respirations were rapid and labored, with an expiratory grunt, and the pulse was soft and rapid. The temperature was 104, the pulse rate 146, and the respiratory rate 42. There was definite pain in the left lower axillary region, worse on inspiration. Slight abdominal distension was noted and there was present a moderate cervical adenitis. There was present in the auditory canal a scanty, sero-sanguinous discharge; inspection of the post-auricular wound showed the mastoid well exenterated and the antrum adequately drained. The white blood count was 24,900.

Nothing was done that night and the patient was seen again at noon the following day. There had been no more chills; the pain in the side, though still present, was less, and the temperature had dropped from 104 the preceding evening to normal. Upon these findings, immediate operation was deferred and a blood culture was taken (seventh postoperative day). The next three days, the seventh, eighth and ninth postoperative days, the condition remained unchanged. The temperature varied from 99 to 105, the pulse remained rapid, and the respirations somewhat accelerated; the pain in the left side was present at intervals, a slight rub was heard low in the anterior axillary line, the spleen was enlarged and tender and some abdominal distension was noted most of the time. These findings, it was felt, pointed to a probable localized pleural infection or a splenic infarct. There were no more chills and the condition of the ear and post-auricular wound remained unchanged.

The blood culture was reported positive for hemolytic streptococcus on the evening of the eighth postoperative day. On this finding operation was decided upon and performed the next day. The mastoid wound was explored and satisfactory exenteration and antrum drainage found. On uncovering the sinus plate, definite evidence of pathological change was observed. Instead of the firm, white bone of a normal sinus plate, there was found a tough, rubbery plate of bone, deep yellow in color, which yielded under slight pressure and felt very much like a thick, fibrous membrane.

The mastoid wound was temporarily covered and the internal jugular vein exposed just below the entrance of the common facial; the latter was divided between ligatures, as was the internal jugular vein below the common facial. The jugular seemed quite normal so far as could be seen in the neck dissection; the wound was closed without drainage.

The mastoid area was again entered. The sinus was uncovered well back toward the confluens sinuum and down toward the bulb as far as possible. When the sinus wall was incised, the lumen of the vessel was found full of a thick, greenish yellow pus; there was no flow of blood. The wall was cut away to the margin of the bone dissec-

tion and each end of the sinus gently curetted. This procedure was followed by a free gush of blood from the distal end and a slight flow from the bulbar end. In view of the extensive dissection necessary to expose the bulb completely, and on account of the normal vein in the neck and the partial flow already obtained from the bulbar end, the dissection was not carried further. The wound was packed with iodoform gauze and left open. The patient suffered very little shock from this procedure and was returned from the operating room in good condition.

The course during the next few days was uneventful; the temperature showed wide variations, ranging from 99 and 100 to 104 and, at times, 105; on the second postoperative day and again on the third, slight chills were noted, followed each time by a temperature of 104. The abdominal distension varied somewhat, some days being almost absent. There was occasional pain in the left chest. The mastoid wound drained moderately; a slight discharge was noted also from the neck wound.

During the two weeks following the operation the patient maintained her nutrition fairly well. The temperature did not show so many high peaks and some progress seemed to be evident. During the third week, while there were no new complications, the patient did not seem to be making any additional progress. An injection of whole blood, taken from the mother, was given intramuscularly in the hope of stimulating resistance. The effect of this procedure was problematical. The injection did seem to influence the course of the disease slightly. The temperature was a little lower during the next few days and the general condition better. During the fourth week, the condition of the patient was such that she was permitted to be up for a short time daily in a wheel chair.

On July 2, at the beginning of the seventh postoperative week, the patient developed lobar pneumonia of the left lower lobe. This resolved by lysis and by the end of the eighth week the lungs had almost cleared and the condition was good. But at the end of another week the temperature again became elevated, the patient became septic, and dullness was found at the left base. Exploratory puncture demonstrated thick green pus; this was drained through a catheter, suction of a large syringe and irrigation with Dakin's Solution being used to remove the pus. Hemolytic streptococcus was cultured from this pus.

In late October, after an illness of five months, the patient was recovering slowly, but satisfactorily. The lung cavity was gradually closing in, the patient was up in a wheel chair and out daily, and her temperature ranged from normal in the morning to 100 or 101 in the evening.

About the first of December the patient acquired an acute respiratory infection and during a severe attack of coughing expectorated about fifteen cubic centimeters of gray, yellow sputum, similar to the drainage from the chest wound. She was still having slight evening temperature but was feeling well and gaining weight.

The last report, dated March 18, 1922, shows scanty, intermittent drainage from the chest wound. The patient feels very well, is up and out every pleasant day, and has gained much in weight.

The reason for reporting this case is to record the recovery of a patient suffering with hemolytic streptococcemia. The prognosis in such a condition is always grave, the mortality being high. But occasional recovery, such as has been recorded in this case, demonstrates that the prognosis is not by any means hopeless. The organism isolated from the blood of the patient was actively hemolytic and was found in the culture in large numbers. The culture was taken forty-eight hours after the last chill so that the presence of organisms in the blood stream at that time would indicate well established infection and not a transient shower of organisms such as may occur at the time of chill in sinus thrombosis cases. The explanation for the recovery of the patient must be found in the shutting off from the general blood stream of the focus in the sinus and the ability of the patient to cope with the infection already present in the blood stream.

The question may naturally be asked, why was not operation done the first time the patient was seen, immediately after the fourth chill. The history of chills was definite and quite typical. There were, however, certain factors which complicated the picture. There was present a cervical adenitis and the invasion of cervical glands by infection following mastoidectomy can give chills strongly simulating those of sinus thrombosis. There was present definite pleural pain, rapid respiration and enlarged spleen, evidence of some acute pulmonary or pleural process, or a splenic infarct. The blood culture had not yet been reported.

The writer feels, in reviewing the case, that too much consideration was given to other processes as possible etiological factors in the septic temperature. The history of four chills following a simple mastoidectomy, in the absence of any other definite cause, is sufficient indication for operative interference in the sinus. The presence of other possible causes does, however, considerably increase the difficulties of diagnosis in suspected thrombosis cases. The same picture, modified by a positive blood culture, leaves, of course, no room for any question as to procedure.

Another point of interest is the occurrence, six weeks after the original infection, of pneumonia and empyema, from which the organism of the original infection was recovered. Was the lung involvement primary in itself or was it a later manifestation of a process initiated at the time of the mastoid trouble six weeks previous? The presence of the same organism would lead one to the latter conclusion.

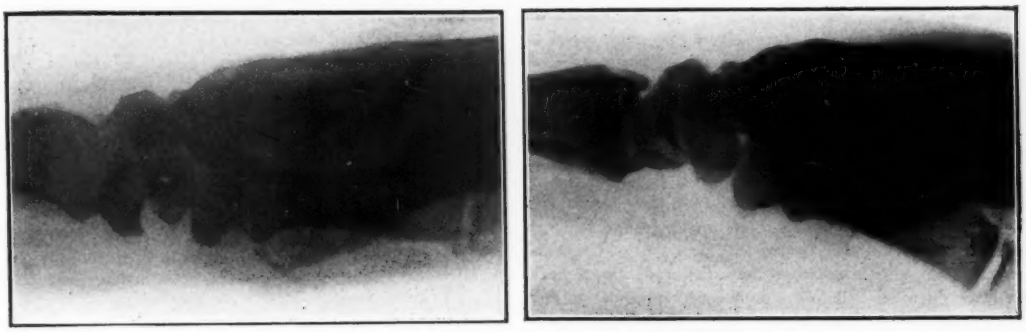
I am indebted to Dr. Charles C. Allen, of Austin, Minn., for permission to report this case and for his notes, both before and after the operation.

A REPORT OF THREE CASES OF DISLOCATED SEMILUNAR BONE

RICHARD R. CRANMER, M.D., AND
ALLEN R. FOSS, B.S., M.B.
Minneapolis, Minn.

Judging from the number of reported cases of dislocation of the semilunar bone, it is of rather rare occurrence.

The hospital records of the Minneapolis Gen-



Case No. 1. Before and after reduction under fluoroscope.

eral Hospital were searched back as far as January 1, 1916, and no other case of dislocation of the semilunar bone was found in the records. After getting three of these relatively uncommon cases within a period of six weeks, it was thought worth while to report them.

In searching the literature, we find that Denk found fourteen cases reported between 1910 and 1920, in addition to fifty cases collected by von Frisch previously.

The semilunar bone is placed in the middle of the proximal row of carpal bones and is crescentic in outline. It articulates with the radius above and with the os magnum and trapezoid below the scaphoid laterally and the cuneiform medially. It has a strong volar ligament and a weaker dorsal ligament; hence, it is usually the dorsal ligament that breaks during a dislocation, while the volar one holds.

A dislocation always occurs when the hand is in hyperextension, the dorsal ligament breaking, and the bone being squeezed out of its place anteriorly by being pinched between the head of the os magnum and the end of the radius. These cases ought usually to be recognized without the roentgen examination, as the semilunar bone can be palpated out of its normal position on the volar surface of the wrist.

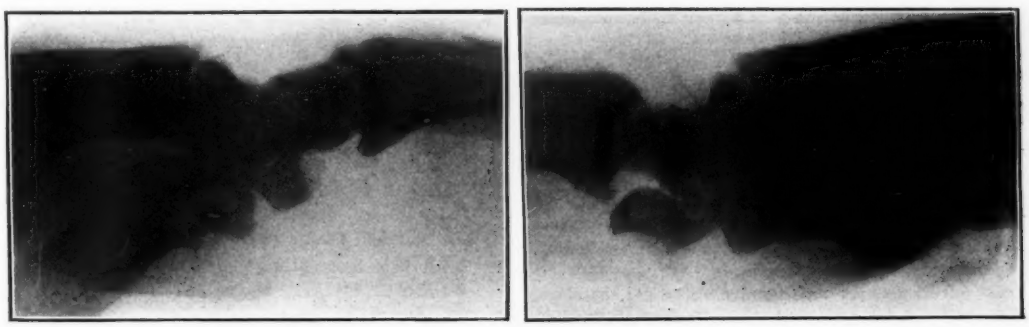
A report of the three cases follows:

CASE 1

Mrs. A. W., aged 53, was admitted to the Minneapolis General Hospital, October 7, 1921, with pain and swelling in the left wrist and hand. Two hours previous to her admission, while trimming a tree in her yard, she had fallen off a ladder, landing on the palmar surface of her left hand, bringing it into hyperextension. She was taken to the hospital by neighbors and admitted on our service. Past history was essentially negative.

On physical examination, we found a rather well developed and well nourished woman with swelling and deformity of her left wrist, which was painful to touch. There was a small laceration on the dorsal surface of her wrist, which was iodized and closed with two dermal sutures. The hand was dislocated laterally and dorsally at the wrist joint. Otherwise, the physical findings were negative.

A roentgenogram was taken, which showed a fracture of the styloid process of the radius and of the ulna with a dislocation of the wrist joint and of the semilunar bone. Under nitrous oxide oxygen anesthesia, the wrist joint was reduced, and another roentgenogram was ordered. The semilunar bone was still dislocated. On October 13, 1921, the patient was again anesthetized and the semilunar bone was reduced under the fluoroscope by using traction on the hand and at the same time hyperextending the hand



Case No. 2. Before and after reduction by the open method (volar incision).

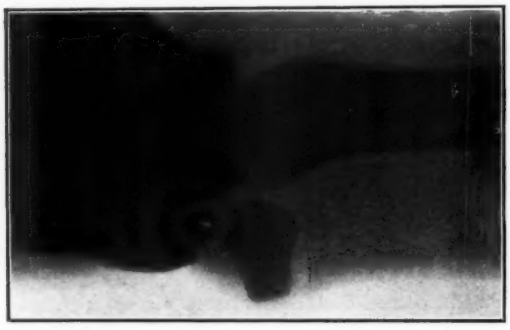
and then flexing it while the assistant pressed his thumb against the bone on the volar side of the wrist distal to the end of the radius. An anterior splint was applied, keeping the hand in flexion to hold the bone in position. She was discharged October 20, 1921. Plates were taken before her discharge (see accompanying plates).

Case 2.

Mr. J. S., aged 39, was admitted to the Minneapolis General Hospital, October 26, 1921, with pain and swelling in his right wrist which he had had for a week. On October 21, 1921, while cranking a Ford, the crank swung back on his right hand, bringing it into hyperextension, causing a deformity of his wrist with pain and swelling. Past history is practically negative.

On physical examination, we found a healthy laboring man, with pain and swelling in his right wrist. One of the carpal bones could be palpated beneath the skin on the volar side of the wrist just distal to the end of the radius. Otherwise, the physical examination revealed no injury.

A roentgenogram of the right wrist showed a dislocation of the semilunar bone towards the volar surface. On October 28, 1921, an attempt was made to reduce it under the fluoroscope with nitrous oxide oxygen anesthesia, using the same procedure as in the above case, but this was not successful. On October 29, 1921, he was taken to the operating room and given an anesthetic and the bone reduced by means of an open incision on the volar side of the wrist. On bringing the hand into hyperextension, the bone snapped back into place with considerable force. The incision was closed with catgut, and three silkworm sutures put in the skin wound. An anterior splint was put on, and two days later plates were taken, showing the bone in good position (see accompanying plates).



Case No. 3. Before excision of semilunar bone.

Case 3

Mr. L. P., aged 22, was admitted to the Minneapolis General Hospital on Dr. F. A. Olson's service at 4:30 P. M., November 18, 1921. At about 3:00 o'clock that afternoon, while washing windows, he fell off a ladder and landed on his side on the cement sidewalk. He sustained a fracture of his left femur in the middle third and a dislocation of the semilunar bone in his left wrist.

Physical examination was negative except for the signs of a compound fracture of the middle third of the left femur and a swelling on the palmar side of the left wrist with severe pain in the wrist. Dislocation of the semilunar bone was diagnosed and proven by a roentgenogram. On November 22, 1921, the semilunar bone was removed. In this case, this was the only thing that could be done because the bone was bulging subcutaneously and was dislocated so far that it could not be reduced even with an open operation. Plates taken afterwards show a good result. An anterior plaster splint was applied with the wrist in a cocked up position.

Conclusions

1. There are three distinct treatments for this condition:
   a. Reduction under fluoroscope and anesthetic.
   b. Reduction by open operation.
   c. Excision of the bone.
2. It is our opinion that most of these cases could be reduced by manipulation without operation if they came to the surgeon within the first twenty-four hours.
3. Forward dislocation of the semilunar absolutely prevents wrist flexion beyond ten degrees.
4. The principal danger of operation is injury to the median nerve, which should be located and carefully retracted before reduction is attempted.
5. Probably a great number of these dislocations, occurring in localities where an *x*-ray picture cannot be taken, go undiagnosed with resulting permanent limitation of motion and painful joint.

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UNUSUAL CASE OF BRAIN ABSCESS AND SINUS THROMBOSIS*

M. G. PETERMAN, Sc.B., A.M., M.D.**

St. Paul, Minn.

This case is reported because of the intense interest which was aroused by the unusual features in the history, in the clinical course, and in the post-mortem findings. Only the essential and important points are reported. The history was taken by Dr. R. K. Dixon:

I. G., a white female clerk, age 20, was admitted on February 17, 1922, at 5:25 P. M.

Chief complaint: "Shooting pains in head" (indicated right frontal region), dull pains in back of head (posterior occipital region). Pain only on right side and apparently in the base of the skull. Slight pain behind the right ear.

Present illness: "Began about Christmas" (December 25, 1921). Patient had a severe cold and sore throat; about January 10, following, the right ear began to ache. The cold improved while the earache continued with intervals of improvement followed by periods of exacerbation. There was no discharge nor impairment of hearing. About February 1 there began headaches in the right frontal region. The pains were sharp, shooting and constant, and always confined to the right side. February 14 there was a dull ache in the right posterior occipital region. This pain steadily increased to the time of admission. On Thursday, February 16, in the afternoon, patient "saw double."

Past history: Measles, mumps, varicella, and scarlatina in childhood. There were no complications, no sequelæ, but complete recovery.

Family history: Essentially negative.

Physical examination: The patient was a well-developed, well-nourished, slender female, twenty years of age, apparently suffering considerable distress and complaining of a severe pain all over the right side of the head, most marked in the occipital region and posteriorly. There was tenderness over the right mastoid region.

Eyes: Pupils equal, regular, react to light. The right eye cannot be turned past the mid-line to the right. Diplopia is present only when patient looks to the right. Paralysis of the right external rectus muscle. Optic discs normal.

Nose: Clear, no discharge, no obstruction, no drainage from sinuses.

Mouth: Mucous membrane normal; tongue clear; teeth good; pharynx clear.

Ears: Left, normal. Membrana tympani normal. Right, showed a slight serous discharge in canal. Membrana tympani pale, grey, dull, with perforation posteriorly.

Neck: Normal.

Chest: Normal; no physical findings.

Abdomen: Negative.

Reflexes: All normal.

Temperature, 100° F.; pulse, 88; respiration, 16.

Diagnoses in receiving room: Otitis media chronic (right); brain abscess; beginning sinus thrombosis (right).

On February 18 the temperature was up to 101.4° F., pulse, 100. Leucocyte count, 12,550. The urine showed a few leucocytes, but was otherwise negative. The patient had slept fairly well; complained of pain in right ear and headache. Examined by the ophthalmologist, who reported the eye grounds negative. Also examined by the neurologist, who reported as follows: "Neurological examination negative, except for involvement of the right sixth cranial nerve. No Rhomberg, no rigidity, no Kernig; corneal reflexes normal and equal. Diagnosis?"

February 19. Condition about the same; still complaining of earache. *X*-ray of skull reported, "Mastoids are of small cell, rather infantile type. Left mastoid clear. Right mastoid shows absence of cells posteriorly to sinus; antrum cloudy. Ethmoid cells clear. Absence of frontal sinus shadow."

February 20. Comfortable night. Patient apathetic. On questioning still complains of headache on right side.

February 21. Condition same. Patient had epistaxis at 10 A. M. and at 3:30 P. M. Had emesis after noon nourishment. Eye grounds negative. Headache about the same. Pupils react sluggishly. Right external rectus paralysis the same. Blood Wassermann negative.

February 22. Complains of intense headache, frontal and occipital. Patient was drowsy and nauseated all day. No localized tenderness except on pressure over the eyeballs. There was a slight rigidity of the neck. Kernig's sign negative.

February 23. Internist (in consultation). "Patient stuporous; rigidity of neck muscles; very suggestive Kernig. *Diagnosis:* Meningitis or possibly brain abscess." *Dental Consultation:* "Unerupted third right molar, otherwise condition good." *Ophthalmologist:* "Eyes negative."

February 24. Fairly comfortable night. Complains of headache and nausea. Appears somewhat brighter. Ophthalmologist reports: "Eye grounds apparently negative, disc margins sharply defined, vessels not distended." Patient now showed definite signs of meningitis. Spinal puncture was done and 40 c.c. of cloudy fluid were obtained, under moderate pressure. The first 5 c.c. was slightly blood tinged. Cell count, 90; polymorphonuclears, 70; lymphocytes, 30; globulin plus; no organisms. Thirty c.c. of antimeningococcus serum was given intraspinally.

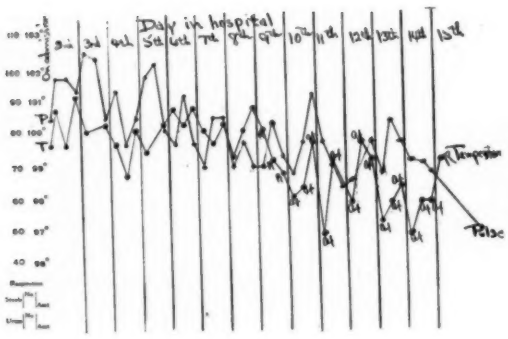
February 25. Patient complains of severe headache, is extremely restless and noisy. Had emesis several times during the day. There is a slight edema of the right upper eyelid. Spinal puncture was done. Thirty c.c. of fluid were withdrawn, under normal pressure, turbid, many pus cells, no organisms. Thirty c.c. of serum were given intraspinally.

February 26. Patient is becoming quite weak. Muscles are rigid. Body is in slight opisthotonos; pupils are fixed. Later the patient became unconscious and went into coma. Spinal fluid was under normal pressure and turbid with pus cells; no organisms were found. Thirty c.c. were removed and 30 c.c. of serum given. The edema of the right eye is more marked.

February 27. Patient responds dully to questions; screams out at times. Body still rigid. Right eye is markedly edematous and ecchymotic. Left eye is slightly

*From the Medical Service of the City & County Hospital, St. Paul, Minn.

**Chief Resident Physician.



edematous. Spinal fluid was under normal pressure. Forty c.c. of turbid fluid were removed, containing many pus cells, but no organisms. Culture of the spinal fluid of February 26 reported positive for staphylococcus.

February 28. Condition about the same, except that the stupor is more marked.

March 1. Patient is more quiet. Spinal fluid full of pus cells; normal pressure; 30 c.c. removed; 20 c.c. serum given intraspinally.

March 2. Patient is very quiet. Spinal fluid under normal pressure and full of pus cells; 25 c.c. serum given intraspinally.

March 3. Patient is extremely dull. Body rigid, in slight opisthotonos. Pupils dilated and fixed, equal and regular. Reflexes not obtainable. Patient died at 9:15 A. M. Autopsy was performed.

Following is the autopsy report as submitted by Dr. G. B. Kramer, Resident Pathologist to the City & County Hospital, St. Paul, Minnesota:

Autopsy was performed March 3, 1922, at 9:30 A. M.

External appearance: Body is that of a well-developed, well-nourished white young female, 171 cm. long. Rigor mortis not yet present and post-mortem lividity confined to the back. Pupils equal and corneæ clear.

Peritoneal cavity: On opening the abdominal cavity nothing unusual is noted in the position of the abdominal organs, or in the boundaries of the diaphragm.

Pleural cavities: Right and left are free from adhesions.

Pericardium: Measures 10.5 x 11 cm. and contains 28 c.c. of clear yellow fluid.

Heart: Muscle is red in color. Consistency is good, all valves are normal and heart weighs 228 grams.

Lungs: Left is crepitant, pink and slightly mottled black. On section the lung is somewhat congested, and there is a small abscess along the anterior border of the lower lobe. Abscess measures 2.5 cm. in width. Weight is 269 grams. Right is same as left and weighs 304 grams.

Spleen: Soft in consistency. Surface is bluish red. On section the Malpighian corpuscles are prominent and in places congested. Measures 14 x 6 x 4.5 and weighs 141 grams.

Liver: Slightly larger than usual and measures 24 x 16 x 8. It is a dark brownish red color. On section it appears cloudy and swollen and weight is 1,644 grams.

Gall bladder: Normal.

Stomach: Slightly congested in places.

Pancreas and intestines: Normal.

Adrenals: Normal.

Kidneys: Left.—Capsule strips easily. Surface is dull red, smooth, and on section it appears cloudy and swollen and weight is 179 grams. Right is identical with left and weighs 178 grams.

Bladder: Contains a small amount of urine.

Uterus: Is of usual size and appearance.

Ovaries: Normal in size.

Fallopian tubes: Show nothing unusual.

Calvarium: Normal thickness. There is no necrosis or erosion of bone at base of skull.

Meninges: Congested over the right and left temporal regions.

Brain: Left posterior cerebellar hemisphere. The cerebellum and the base of the brain is filled with muco-purulent yellow pus. The brain in the left temporo-frontal region is scooped, soft, necrotic and filled with pus. The softened area measures 4 x 4 cm. There is a hemorrhage in the left cerebellar lobe. The hemorrhage extending towards the left superior peduncle. There is an abscess 2 x 3 cm. in the left cerebellar lobe and there is an opening from the surface extending into the abscess. Cultures of this pus showed staphylococcus.

Sinuses: The right and left cavernous sinus show septic thrombi. The left and right superior and inferior petrosal sinuses and the circular and transverse sinuses are filled with pus. The right drum is perforated. The margin of the perforated drum is thickened and raggedy. The left ear drum is edematous. There is no pus present at, or around, the drum.

Anatomical diagnosis: 1. Acute localized meningitis. 2. Focal brain necrosis. 3. Cerebellar abscess. 4. Septic thrombosis of sinuses at base. 5. Chronic otitis media (right). 6. Acute toxic nephritis. 7. Acute toxic hepatitis. 8. Metastatic abscess of lung (left). 9. Acute parenchymatous splenitis. 10. Slight congestion of stomach.

COMMENT

The diagnosis of brain abscess and beginning sinus thrombosis, as made in the receiving room, were, of course, somewhat far-fetched. The subsequent course of events substantiated the diagnosis. The treatment of this case was purely symptomatic, until the development of the meningitis. There was at no time a definite indication for surgical intervention. The internists, surgeons, oto-laryngologists and the neurologists, were all agreed that at no time were there localizing symptoms indicative of radical treatment. The meningitis was treated with antimeningococcic serum, because at first no organisms were found, and the possibility of an epidemic meningitis was considered. With the post-mortem findings there can be little doubt but that the infection was primary in the right ear.

A CASE HISTORY OF FRACTURED PELVIS

E. H. MARCUM, M.D., AND
R. J. MCADORY, M.D.
Bemidji, Minn.

The following case is especially interesting, not only from the fact that the injury was so extensive, but from the number and variety of complications which arose and which are the things which add zest to the practice of medicine and surgery.

If every case followed a cut and dried course, I venture to say that few of us would stay in the game very long. It is the excitement and expectancy of something new always coming up in our daily work that really makes it worth while and keeps each one of us alive to our better selves.

Case history: H. V., married, aged 26, farmer, of German descent, with no past history of any consequence, had always been healthy and a hard worker.

On August 31 last, while riding a horse, he reined it in sharply and the horse reared up, fell over backward and landed squarely across the abdomen and pelvis of the rider. He suffered severe pain over the lower abdomen and back, being unable to get up, and the pain was so severe on attempting to move the legs that this was practically impossible.

A short time later he found the urine bloody. He was nauseated but did not vomit nor did he lose consciousness at any time. Defecation showed no blood.

Urination became increasingly more and more difficult until it completely stopped on the morning of September 3, when he was admitted to the hospital and came under our care. On examination we found no deformity or shortening of the legs though attempts to move them caused great pain, and jarring on the bottoms of the feet with the limbs extended was also painful. Pressure on the pelvic bones was not especially painful but a twisting of these bones caused excruciating pain. He was very tender over the bladder and dullness extended a considerable distance above the pubis. Temperature was 99.4 and pulse 102.

On catheterization we removed 22 ounces of very thick bloody urine, which relieved him to a considerable extent. The bladder was irrigated with boracic acid solution, which returned with difficulty, showing that the catheter was being plugged by blood clots and the return solution did not clear at any time.

The bowels not having moved for two days he was given two ounces of castor oil, which acted at five-thirty the same evening normally, and showed nothing out of the way.

He slept at intervals during the day. During the evening an orderly passed a catheter easily again but there was no return. I called and introduced the catheter easily and after no flow introduced a little boracic acid solution, which started a free flow of bloody urine.

On September 4, morning temperature 101, pulse 98, general condition the same. During the night he had been given one-half grain of codein hypodermically for pain. He passed an easy day with an evening temperature of 101.2, pulse 102.

September 5, A. M. temperature 99.4, pulse 96. Urine, passed partly voluntarily and partly through catheter, was still very bloody. Soapsuds enema gave good results. Evening temperature 101.2, pulse 98. A light cathartic was given this evening and during the night he was given codein twice for pain.

During this time he had been on light diet and taking a fair amount.

September 6. A. M. temperature 100, pulse 106. He complained of pain in the left lower abdomen, which was aggravated by application of heat. This evening he had a temperature of 99.6, pulse 122, and during the night he had severe pain and was given one-quarter grain of morphine. Pulse during the night remained at about 120. The bladder was irrigated twice daily with boracic acid but showed no signs of clearing.

September 7. Temperature 99, pulse 110. Abdomen distended but not rigid and no vomiting. A rectal tube was inserted and a large amount of gas passed, giving almost complete relief. Evening temperature 101.4, pulse 104. During the night he was very restless and pain around the bladder necessitated morphin twice.

September 8. Patient rested fairly well and voided urine normally, but it was still bloody but clearing considerably. Temperature 99.6 but pulse 136 and very weak and thready. Abdomen distended but not tender. Soap enema freed a large amount of gas and relieved his pain, but had no effect on the pulse. At noon the temperature was 98.4, pulse 132 and he was perspiring freely. He was given a hypo of camphorated oil 1 c.c. with no effect.

At three P. M. he was given morphin, gr. ¼, with atrophin gr. $\frac{1}{150}$ and under novocain one-fourth per cent an opening was made down onto the bladder. The space just above the pubis was filled with fluid and blood clot, which was cleaned out and an opening found in the bladder made by a piece of bone from the posterior side of the pubis, which had been driven into the bladder, making a rent about one inch long. The bladder was filled with blood clots, which were evacuated, and then another laceration about one and a half inches long in the posterior wall of the bladder was found just above the trigone, with another piece of bone, about the size of a quarter, very firmly attached to the tissues over the hollow of the sacrum. No opening into the abdominal cavity was found. Owing to the condition of the patient and the piece of bone being very adherent, it was left in place and the bladder connected with an intermittent syphon as in a suprapubic prostatectomy.

He passed a very poor night but the morning found a temperature of 100.4 and a pulse of 108. Calomel, followed by a light saline and a soapsuds enema cleared the bowels well and by evening the temperature was 100.2, pulse 96.

He suffered very little for some days after the operation and slept fairly well, also taking a fair amount of liquid nourishment, about the only medication being a little urotropin.

September 14 his temperature began to rise, accompanied by a swelling in each parotid gland, which continued to get worse for the next two days, with the temperature going to 103 and pulse to 108. The abdominal condition was satis-

factory. There was no fluctuation or redness in the glands at any time. Glands were coated with a mixture of equal parts of 10 per cent ichthyol and belladonna ointment. The only other symptom aside from pain in the glands was a little vomiting.

After the first twenty-four hours the temperature gradually fell till it reached normal on September 21. By this time the condition was that of extreme emaciation and what is often referred to as a typhoid condition. He was put on Elixir I. Q. S. and hypodermics of strychnin, gr. 1/30, four times a day for the next week with concentrated liquid foods and a little panopeptone and liquid peptonoids.

During the following week he developed a broncho-pneumonia just to add to his pleasures.

On October 1, due to the emaciation, which was extreme, and to the impossibility of keeping him perfectly dry, a large slough formed over the sacrum, taking practically all the soft tissues down to the sacrum. Boracic acid, zinc stearate, etc., were tried on this but gave no relief, so that we changed to Dakin's solution, which stopped the extension of the slough and the pus began to clean up.

For some time we had also been using Dakin's solution for bladder irrigation and had had very little pus from it.

During the first week in October he vomited practically everything and would only retain a few teaspoonfuls of buttermilk, albumen-water, etc., while his temperature varied from 96.5 to 97.5 with a pulse of 100 to 120.

His principal complaint during this time was pain in the abdomen with a desire for defecation though he had involuntary movements every day; this desire we were unable to relieve.

About the 10th of October he began to gradually pick up a little and the temperature returned to normal though he was very restless and slept very little.

On October 15 the temperature gradually began to rise again with the developing of an abscess in the abdominal wall to the left of the incision. This drained through the edge of the incision but the temperature did not fall, but rather went higher and became the septic type, 103 at night and 99 in the morning. This was accompanied by a swelling of the left thigh though with little induration and no redness.

The patient complained on urination of a gurgling sensation in the thigh and soon on tapping we could get a succussion sound and by pressure on the thigh pus was expelled from the meatus. The thigh was incised at about the middle, over the adductor magnus, and a moderate amount of pus evacuated; but when he came to urinate about half of the urine came through the wound in the thigh.

The temperature now gradually dropped to 99 or 100 and he began to pick up rapidly though there was no cessation of the discharge in the thigh.

The hospital *x*-ray apparatus had been out of order and we did not feel that his condition had justified our taking him to the office for this work till November 28, when I should estimate that he had gained about twenty-five pounds over his low point. We then took him down and filled the sinus in the thigh with bismuth paste when the *x*-ray showed the cavity extending up to just in front of the prostate, where there was evidently an opening into the urethra, which accounted for the discharge of urine only on urination, it being outside the sphincter.

The pelvis was also rayed from two angles, one picture showing a longitudinal fracture in the sacrum and the other a fracture of the ascending ramus of the left ischium. There is also an osteomyelitis of the wing of the right ilium. I should have mentioned that he had been complaining of pain and tenderness over the right ilio-sacral synchondrosis and over the rim of the ilium for the last two weeks though there was no redness but a little puffing.

The bismuth paste plugged the urinary fistula and it has apparently healed though there is still a slight suppuration from the opening in the thigh.

On December 5 we made an opening over the rim of the right ilium and found the periosteum raised up from the bone on the inner and outer side for an area of about two inches square, the space being filled with a soft granulation tissue and the bone soft and oily on pressure of the rongeur. The soft bone was removed till we reached bleeding bone and the periosteum replaced, the wound being partially closed and drained. Healing is taking place nicely here.

The temperature gradually became normal and he was allowed to go home on December 19 to report occasionally on the condition of the thigh and ilium.

Now with the chance for extravasation of the urine that there was in this case why did he go nine days without showing any great signs of sepsis and why did the pulse become so suddenly weakened?

Did the devitalized tissues hold and prevent extravasation till a day or two before the collapse?

Then the parotitis, was it mumps or metastatic infection from the bladder? The period of twelve days in the hospital with no other cases around does not preclude the former. On the other hand no other cases developed from this.

Again, how was the ruptured urethra produced in that area and how did the fistula come to open half way down the thigh instead of the urine following up Colles' fascia over the abdomen or producing an abscess in the perineum?

MINNESOTA MEDICINE

Owned by
The Minnesota State Medical Association.
PUBLISHED BY ITS EDITING and PUBLISHING COMMITTEE
R. E. Farr, M.D. Minneapolis
H. Longstreet Taylor, M.D. St. Paul
L. B. Wilson, M.D. Rochester
F. L. Adair, M.D. Minneapolis
J. T. Christison, M.D., St. Paul

EDITORIAL OFFICE
CARL B. DRAKE, M.D., Editor
403 Central Bank Bldg., St. Paul

BUSINESS MANAGER
J. R. Bruce, 403 Central Bank Bldg., Saint Paul
Telephone: N. W. Cedar 1683
210 Commercial Bldg., Minneapolis
Telephone Atlantic 2610

All correspondence regarding editorial matters, articles, advertisements, subscription rates, etc., should be addressed to the Journal itself, not to individuals.

All advertisements are received subject to the approval of the Council on Pharmacy and Chemistry of the American Medical Association.

Subscription Price: $3.00 per annum in advance. Single Copies 25c. Foreign Countries $3.50 per annum.

Vol. V August, 1922. No. 8

EDITORIAL

The Rockefeller Foundation

The career of Dr. George E. Vincent, recently president of the University of Minnesota and now president of the Rockefeller Foundation, is of particular interest to the many Minnesotans who have come in touch with his brilliant mind. Few realize the literally world-wide and almost unbelievable magnitude of the humanitarian organization he supervises.

An expression of the activities of the Foundation in dollars and cents gives an idea of the extent of the resources and disbursements of this organization. Its working capital amounts to some $174,511,957 and its physical property is valued at $8,666,813. From the time the Foundation was chartered in 1913 it has disbursed, appropriated or pledged a total of $84,301,394. Last year its disbursements totaled $7,444,565, while its administration expenses amounted to only $185,792. We wonder how much it would cost the government to administer such a sum.

An accurate valuation of this institution in dollars and cents is impossible, for its contribution to the world at large expressed in money value is doubtless several times this amount through the prevention of economic loss from human disease; for the institution is primarily one concerned in the prevention of disease and the furtherance of medical science and therefore of very particular interest to the profession.

Enormous strides have been made in preventive medicine and the subject is well summarized in Dr. Vincent's report as follows:

"the presence of smallpox is now a disgrace to any civilized community or country; cholera and plague have disappeared from the leading nations; typhoid fever has been enormously reduced; malaria and hookworm disease are giving ground; yellow fever is being narrowly restricted; typhus is practically unknown among a cleanly people; the fear of diphtheria has been largely allayed. Such victories as these, together with advances in general sanitation, higher living standards, more attention to individual health habits, have resulted in steadily falling death rates in all the more progressive countries.

"But it is too early to feel complacent. Only a beginning has been made. Many diseases still baffle the health authorities. Whole regions have been almost untouched. Even the most advanced communities fall far short of what might be attained. The average individual remains relatively ignorant and negligent of sanitary science and of personal hygiene. Almost all physicians are still too exclusively concerned with the individual aspect of disease."

It is true that we as physicians are prone to limit ourselves to the view of our practice as made up solely of individual cases. The human mechanism is so variable that this individual treatment is necessary. And yet when we come to consider the very limited scope of our ability to treat after our very elaborate diagnostic investigation we are forced to admit the much greater value of preventive medicine.

Medical men as a whole have failed to see the vision of preventive medicine. Preventive medicine heretofore has been typified by Health Departments and these have been so much under the influence of politics and so underpaid that medical men have been in the habit of looking down on this form of preventive medicine. The uncertainty of the job deters the average physician from this line of work.

One of the important activities of the Foundation has been the contribution last year of three-quarters of a million dollars to the School of Hygiene and Public Health of Johns Hopkins University. Harvard has been pledged two million for a similar school. This means that the country is to be supplied with trained public health specialists and we venture to predict that preventive medicine is coming into its own.

The New Child Hygiene Division of the State Board of Health: Its Relation to the Physicians of Minnesota

The accumulation of evidence showing that there is a very pleasing and vital need for the "promotion of the welfare and hygiene of Maternity and Infancy" has led to the passage of a Federal Act for that purpose—the Sheppard-Towner Act, approved November 23, 1921.

The beginnings of the agitation for improvement in the hygiene of maternity and infancy were long ago. Progress was slow, for it had to contend with an inertia, a fatalistic conception that Providence, in the guise of a midwife, had taken the field of obstetrics for its own. Gradually societies and organizations were formed, inspired by the spectacle of maternal suffering and death and of an incredible infant mortality. They sought to make others aware of the almost unbelievable situation and they worked hard to gather material which might help in their search for the cause, ultimate effect and cure. During the past ten years these organizations have grown greatly, until at present there are some eighty-three national organizations engaged in whole or in part in some phase of the problem. They have conducted numerous demonstrations, inspired a large amount of legislation and have spread their propaganda continually in every direction. Then there are state and municipal, county and district organizations, so that the accumulation of thought and effort should be tremendous and overwhelming. The personnel of these organizations includes thousands of individuals trained in some phase of infant, child and maternal hygiene and they enlist the sympathy and co-operation of many others.

What is the reason for such tremendous and widespread activity? What is to be done and how?

The reason for all this work is to be found in the conviction in the minds of an increasing number of men and women that babies and children by the thousand die unnecessarily or advance towards the duties and responsibilities of a United States citizen and potential parent with an unnecessary handicap of deformity or poor health; and that maternity, at present, holds too great a threat of death or disability. They know that this loss can, to a large extent, be prevented and they hope to prevent it by a variety of means which may be summed up in the word *education.*

This education is to be spread by every vehicle of popular propaganda. It has for its ultimate object the creation of a universal conviction of the reasonableness of the proposition that women ought not to suffer a preventable death in bringing children into the world; that, having borne them, they ought not to lose them through disease, mostly preventable, and that the babies, themselves, ought to receive no unnecessary burden of ill-health to handicap them in their coming years.

This popular education has already begun to foster a demand for purely preventive medicine, particularly in pediatrics and obstetrics, to the satisfaction of which the physician must give an increasing amount of his consideration. The proper satisfaction of this increasing demand by the family physician, the man who, in the final analysis, will most often be the one who must give it, will do more perhaps than any single other factor in fulfilling the aims and hopes of the Child Welfare Movement in America. To him should come the forward looking ones with their anticipations and the anxious ones with their misgivings and fears and he must deal with the future and potential of sickness rather than with the present and actual. And since a pressing and active curiosity is the beginning of knowledge, progress may be expected in direct ratio as this curiosity is satisfied.

The medical profession must become conscious, then, that there is growing among the millions of people in our country in response to this steady and all-pervading propaganda a demand for a type of medical attention that is as yet not generally practiced. The people are beginning to feel that along certain lines they have been groping in darkness. They are beginning to inquire for more light, since they are being told continually that there is more light. The man to give this light is the average practitioner, wherever he may be, in the country, town or city. Should he fail to respond through the channels which are open to him with sympathy and with understanding to this awakening health consciousness of the people, then they must seek elsewhere for guidance. And every physician knows how even now false leaders, some lay and some with pseudo-science, stand ready and anxious to assume a leaderhip which may be taken safely only by those men whom the state has trained for such leadership.

The Division of Child Hygiene hopes to work with the physicians of the state in this campaign of education. Dr. J. Witridge Williams says that a

physician is not a servant, he is a teacher. Our obligations to society will never be completely fulfilled until we teach our communities how to avoid disease as well as treat for disease which, sometimes, of course, will come to everyone.

—E. C. H.

Mal de Mer

It may be recorded somewhere, the surprise that first appeared on prehistoric man's face when, in his tree dugout, he first noted the curious cerulean hue in his wife's face as he paddled along, but the reference is not now available. In any case, much time has elapsed, and many observers have had a chance to venture either etiological fundaments or therapeutic panacea. So grief is said to reduce all mankind to a common level, but it cannot compete in that expedient with some seasickness. This level is not only physical, but it is moral and spiritual. Great naval commanders must have early developed means of relief; I cannot conceive anyone in *command* embarrassed by an inward obsession that harbors no rivals.

There is a common assumption that children do "not get seasick." This, like many similar dicta, is wrong. Yesterday I saw what was formerly a ruddy-faced youth wrapped up in a blanket, and his sorrowful countenance and pale face betokened a striking terminal nephritis or pernicious anemia. Yet, he was a luminous planet compared with a naturally tired looking teacher, a bit asthenic at best, fired with an ambition to live and see, far out of keeping with her physical endowment. Let us leave her alone to her sorrow and happiness. It is awful to be seasick, but a fine topic later for home conversation—anyway, she is not in shock. How much of mal de mer is mental?

Several of the lounging rooms in this boat are equipped with a curious type of fireplace: artificial coals repose in the cheerful looking grate, as we often see in gas connections. But the fine, stimulating glow behind is not from a flame but from especially devised electric bulbs. In addition, a sort of fan on the inside rotates, and, sitting back, a shadow is seen above the "flaming mass" exactly as if heat waves were rising against the usual paneling of the grate overhead. Few approach there on these chill days in the North Atlantic, without envying those "before the fire." Yet, as the fog and dampness deepened, the camouflage didn't work, and gradually the cold hands were brought in actual contact with the "flaming coals," only to find them a little colder, if anything, than anything else. Now, let us reverse this set of conditions, and on a warm day the grates are shunned, and if one should come in after a brisk walk, such a "stifling situation" would be unendurable.

If you have followed me you will sense why it is that the casual stagger of a man on terra firma would lead those about him to watch him with the very greatest interest to attempt to decipher a possible lead as to where he got it—animation emanates. But let the same man casually do the same on shipboard, even in a situation of calm and even keel, and a fair number will adopt a look of the most extreme disgust, cast furtive glances toward the rail, and despise him as a plague-stricken intruder.

Distant voices at times lend a charm, and even a distant brawl excites the imagination, but let some overwrought occupant of an adjacent berth let out just one gastric howl (the wolf-like call of the diaphragm confused and obsessed), and the whole pack responds with a chorus of answers where previously all was silence and tranquillity. Wolves only gather in packs for offense—and seasick folk have no powers of offense—hence, they also steal off into the silent places (usually their bunks), where the lair as of others reduced to primitive conditions takes on the outward evidences of neglect, including the characteristic aroma of gastric juice.

—E. L. T.

OBITUARY

DR. JOSEPH A. GATES

Dr. Joseph A. Gates of Kenyon, one of the most prominent men in his community and county as well as in the state of Minnesota, was instantly killed the morning of June 15, when his automobile, in which he was driving alone to answer a call, was struck by a Chicago Great Western passenger train on a crosisng two miles south of Kenyon.

Dr. Gates was born September 11, 1870, at Oronoco, Minnesota, the seventh son of Elnathan and Jane Waldron Gates. He was graduated from the Rochester, Minnesota, High School and decided to make medicine his life work at that time. His medical course was obtained at the expense of much real sacrifice and hard work. He graduated in 1895 from the University of Minnesota medical school, being president of his class and assistant to the professor of chemistry.

On June 10, 1898, he was married to Jennie A. Clark of Rochester, who, with their six children, survives Dr. Gates.

The practice of medicine was taken up at Kenyon imme-

diately upon his graduation and Dr. Gates had since established himself as a leader in community affairs in general. In 1898 he was elected a member of the board of education, later clerk and president, remaining on the board until his death. In 1901, Dr. Gates founded the Kenyon telephone exchange. He was also very active in working for the establishment of the Tuberculosis Sanatorium at Mineral Springs and was a director of the Citizens State Bank of Kenyon.

It was not only in Kenyon that Dr. Gates was active in business and political life. He was a member of the state legislature from 1904 to 1908 and was for years a member of the State Central Committee for the Republican party.

During the war, Dr. Gates not only sent his two sons into the service, but also enlisted himself in 1918, serving as captain in the Medical Division of the U. S. Army at Fort Riley, Kansas, Camp Travis, Texas, and Camp Meade, Maryland, as commander of the 52nd ambulance unit. He was first vice commander of the State American Legion at the time of his death.

Dr. Gates was a member of the Blue Lodge, Royal Arch Chapter, and commander of the Masonic Order and a Mystic Shriner of the Osman Temple, St. Paul. He also belonged to the Elks, I. O. O. F., M. W. A., A. O. U. W., Eastern Star and the Degree of Honor.

The esteem and good will in which he was held in his own community marked the respect of those who came to know him elsewhere as well. It is felt that his is an irreparable loss to the country in which he lived.

DR. WILLIAM P. O'MALLEY

Dr. William P. O'Malley died at Shakopee, Minnesota, Sunday, July 9, 1922, as a result of injuries he sustained in an automobile collision near that city while driving to his home in St. Paul from Prior Lake.

Dr. O'Malley was born at Westport, near Madison, Wisconsin, in 1874. He graduated from St. Thomas College in 1898. The same year he entered the medical college of the University of Minnesota, from which he was graduated in 1902. The year following he served his internship at St. Mary's Hospital in Milwaukee. From there he went to Elkhorn, Wisconsin, and began the practice of medicine. He continued there until 1906, when he removed to St. Paul, Minnesota. From that time he was actively engaged in general practice until he entered the military service of the United States in July, 1917.

He was commissioned a First Lieutenant in the Medical Corps and entered the medical officers' training camp at Fort Riley, Kansas. He was assigned to the 313th Sanitary Train, 88th Division, in September, 1917. He was promoted to Captain in April, 1918, and went to France with his unit in August of the same year. He saw active service on two fronts, the Alsace and Meuse-Argonne. After the armistice he was one of the medical officers assigned for special study at Toulouse University.

Upon his return to the United States, Dr. O'Malley did post-graduate work in urology at Johns Hopkins University. Since his return to St. Paul in March, 1920, he limited his practice to that specialty.

Dr. O'Malley as a physician and as a citizen was beloved of all who knew him. He was ever frank, generous and sincere, brave and sympathetic. Loyalty was a fetish with him. Numerous friends mourn his untimely death.

DR. JAMES N. METCALF

Dr. James N. Metcalf of Monticello, while returning from the country, where he had been making a professional call, was fatally injured at the Buffalo road crossing of the Great Northern Railway, Sunday, February 12, 1922, at about 1:20 p. m., when the engine of the train hit his team as it was crossing the track. Dr. Metcalf was placed on the train and taken to St. Raphael's Hospital at St. Cloud, where he died soon after reaching the hospital. Dr. Metcalf had lived in Monticello for more than 15 years, coming there in August, 1906.

James Nattrass Metcalf was born at Benton, Wisconsin, January 20, 1881. With his parents he moved to Dubuque, Iowa, in 1893 and after graduating from the high school of that city he moved to Minneapolis and entered the University of Minnesota in 1899, taking up the medical course, from which he was graduated in 1905. After one year in hospital service in South Dakota, he came to Monticello.

On October 9, 1907, he married Miss Mildred Brunskill of LeMars, Iowa. She, with their two children, Kenneth and Maxine, his parents, James and Margaret Metcalf of Minneapolis, three brothers, Thomas of Dodgeville, Wis., Leonard of New London, and Clinton of Minneapolis, and one sister, Mrs. William Robson of Cuba, Wis., survive him.

DR. SAMUEL F. HANCE

Dr. Samuel F. Hance, a pioneer member of the medical profession in Minneapolis, died last month at the home of his daughter, Mrs. Charles J. Thistlewaite, Fairport, N. Y., at the age of 97 years. Dr. Hance left Minneapolis in 1902 to live with his daughter, after a practice of thirty years in that city.

He was born in Marion, Ohio, July 1, 1825, and received his medical degree from Albany Medical College in 1855. Dr. Hance began the practice of medicine in Buffalo, N. Y., and later went to Aurora, Illinois, where he remained for fifteen years. In July, 1862, he enlisted in the 89th Illinois Volunteers as a surgeon with the rank of major, and served until April, 1863.

He came to Minneapolis from Illinois in 1873 and continued his practice until the time of his retirement.

Dr. H. H. Haskins, 78 years of age, who practiced medicine for thirty-three years at Canton, Minn., died at his home in Cassadaga, Florida, May 9, 1922.

Dr. Conrad W. Wilkowske of Chippewa Falls, Wis., formerly of Faribault, Minn., was drowned while fishing in Lake Bob, near his home, June 17. Dr. Wilkowske practiced medicine in Faribault for nearly six years after graduating from the school of medicine at the University of Minnesota. He then went abroad to Vienna to specialize in eye, ear, nose and throat diseases. From there he went to Chippewa Falls to practice his specialty. He was 48 years of age.

Dr. Charles Van Cappellen of St. Paul died at his home in January at the age of 66 years.

REPORTS AND ANNOUNCEMENTS OF SOCIETIES

MINNESOTA STATE MEDICAL ASSOCIATION MEETING

The next meeting of the State Medical Association will be held in Minneapolis in the latter part of October. The President, Dr. J. Frank Corbett, has practically completed the selection of the personnel of the various committees and the decision has been made to hold the meetings at the University. This will provide a meeting place conveniently accessible to both Minneapolis and St. Paul and make it possible to have the various halls and exhibits close together. The Dean and Faculty of the Medical School, through Dr. Arthur Strachauer, Chairman of the Campus Committee, have promised their active co-operation even to the extent of dismissing the classes of the school on the days of the meetings.

The program is being arranged with a view to being of particularly practical interest to the men on the "firing line" of clinical medicine. The general arrangements are in charge of a committee headed by Dr. Edwin L. Gardner.

Dr. Stanley R. Maxeiner is in charge of the exhibits, both scientific and commercial, and is planning on an unusually large amount of material.

Details of the entertainment features will be announced at the time of publication of the complete program.

WABASHA COUNTY MEDICAL SOCIETY

The annual meeting of the Wabasha County Medical Society was held at Wabasha Thursday, July 6, with an attendance of thirty.

Papers presented at the meeting included:

The Modern Conception of Heart Disease—President's Address—Dr. Hugo Branyan, Wabasha.

The Heart in Thyroid Toxemia—Dr. John T. Bowers, Lake City. (Read by title.)

Myodegeneration and Heart Disease of Middle Age—Dr. George E. Fahr, Minneapolis, Assistant Professor in Medicine, University of Minnesota.

The Functional Heart Tests in Diagnosis and Prognosis—Dr. D. S. Fleischhauer, Wabasha.

The Present Status of Digitalis Therapy—Dr. E. H. Bayley, Lake City.

Officers elected for the coming year included: President, Dr. L. F. Sutton, Mazeppa; vice president, Dr. G. Schmidt, Lake City; secretary-treasurer, Dr. W. F. Wilson, Lake City; delegate, Dr. H. E. Bowers, Lake City; alternate, Dr. W. H. Replogle, Wabasha; censor for three years, Dr. A. A. Rankin, Zumbro Falls.

A dinner was served at the Buena Vista Sanatorium through the courtesy of the Tuberculosis Commission of Wabasha and Winona counties.

It was voted to send ten dollars out of the funds of the society to the committee for "American Medical Aid in Russia."

REDWOOD-BROWN COUNTY MEDICAL SOCIETY

The Redwood-Brown County Medical Society held its annual meeting in Sleepy Eye State Park on the afternoon of June 15. At this meeting the following officers were elected for the ensuing year:

President—Dr. Earl Jamieson, Walnut Grove.

Vice President—Dr. F. J. Pelant, New Ulm.

Secretary-Treasurer—Dr. Wm. A. Meierding, Springfield.

Delegate to State Meeting—Dr. J. C. Rothenburg, Springfield.

Alternate to State Meeting—Dr. Theo. Hammermeister, New Ulm.

Censor for Three Years—Dr. Geo. B. Weiser, New Ulm.

Drs. Rothenburg and Hammermeister were appointed as a legislative committee to act with the state legislative committee. After the business session, the doctors and their wives enjoyed a social outing and picnic lunch in the park.

CENTRAL MINNESOTA MEDICAL ASSOCIATION

The summer meeting of the Central Minnesota Medical Association was held at Litchfield, June 13. Business as well as social sessions were held at the Robertson cottages at Lake Ripley.

The presentation of five papers composed the program, which included the following:

Milk and Its Relation to Public Health—Dr. George E. Sherwood, Kimball.

The Limits of Local and Regional Anesthesia in Surgery—Dr. Richard R. Cranmer, Minneapolis.

The Treatment of Menorrhagia with Radium—Dr. F. T. Brigham, Watkins.

X-Ray Diagnosis of Some Gastro-Intestinal Diseases—Dr. A. F. Branton, Willmar.

Gastric Symptoms Not Due to Gastric Diseases—Dr. R. E. Anderson, Willmar.

Visiting ladies at the convention were entertained by the wives of the Litchfield physicians and in the evening a banquet was served to all delegates.

MINNEAPOLIS, ST. PAUL & SAULT STE. MARIE RAILWAY SURGICAL ASSOCIATION

The fifteenth annual meeting of the Minneapolis, St. Paul & Sault Ste. Marie Railway Surgical Association will be held at Minot, North Dakota, September 25 and 26.

OF GENERAL INTEREST

Dr. J. E. Arnold, formerly of Eveleth, has taken up his practice in Vernon Center.

Dr. F. H. Neher and Miss Cecelia Kilbane, both of St. Paul, were married July 12, 1922.

Dr. C. W. Paulson and family of North Branch are taking a vacation trip to the Pacific coast.

Dr. G. N. Ruhberg of the City and County Hospital has located at 821 Lowry Building, St. Paul.

Dr. E. V. Mastin, who received the degree of M. S. in Surgery in June, will locate in St. Louis.

Dr. J. T. Asbury of Rochester has located for the practice of medicine at Stewartville, Minnesota.

Dr. Carr of Boston has become associated in practice with Dr. E. P. Hawkins at Montrose, Minnesota.

Dr. J. W. Ross, whose fellowship in the Mayo Foundation expired July 1, has located at Toronto, Canada.

Dr. J. J. Stratte, formerly of Minneapolis, has become associated with Dr. Arthur W. Shaleen at Hallock, Minnesota.

Dr. F. C. Lorenzen, formerly of Elgin, N. D., has located in Richfield and has opened his offices at 5560 Nicollet Avenue.

Dr. and Mrs. H. E. Binet of Grand Rapids have returned from a three weeks' motor trip through the East and Canada.

The ceremony of presentation to Dr. L. B. Wilson of a Distinguished Service Medal took place at Fort Snelling June 26.

Dr. and Mrs. E. J. Tiedemann and daughter Helen of Adrian have returned from a camping and fishing trip in Wisconsin.

Drs. Olaf Sand and Hans Haugen of the Fargo clinic are spending their vacations at Fair Hills, Pelican Lake, Minnesota.

Dr. M. E. Withrow of International Falls is attending to his practice again after several weeks in the hospital at Brainerd.

Dr. H. M. Johnson of Dawson has visited several clinics the past month, including the Fargo and Bismarck clinics in North Dakota.

Dr. V. P. Hauser of the City and County Hospital has become associated with Dr. F. C. Schuldt in the Lowry Building, St. Paul.

Dr. and Mrs. James Blake and their children of Hopkins have returned from a six weeks' automobile trip through the East and Canada.

Dr. and Mrs. Frank A. Allen of Ironton have returned from an automobile trip to Grand Marais, Port Arthur and other Canadian points.

Dr. G. J. Furreira, formerly of Iowa, has located at Aurora and will be associated in his practice with Dr. C. W. Bray of Biwabik.

Miss Virginia Cole, daughter of Dr. and Mrs. H. B. Cole of Redwood Falls, was an honor graduate at Northwestern University this spring.

Dr. and Mrs. William A. Meierding of Springfield spent a week the latter part of June camping and touring through the northern part of Minnesota.

Dr. O. G. Engstrand of Brownton, who has been ill with pneumonia at the Swedish Hospital, Minneapolis, has been reported as slowly improving.

Dr. F. H. Stangl of Chicago has moved to St. Cloud, where he has entered partnership with his brother, Dr. P. E. Stangl, in the practice of medicine.

Dr. P. Blanco has left the Mayo Clinic, having completed his fellowship, and has gone to Buffalo to work as orthopedic surgeon in Dr. Butsch's Clinic.

Dr. L. T. Murphy, who has completed his fellowship in the Mayo Foundation, has left the clinic to begin practice in the Nicollet Clinic, Minneapolis, Minnesota.

Dr. W. G. Walters, who has been located at Pine City for the past three years, has moved to the northern part of the state to engage in contract medicine.

Announcement has been made that Dr. M. A. Trow, who has been practicing in Dakota the past thirty-eight years, will establish his medical practice at Chatfield.

Dr. Walter Stilwell of Appleton is a recent graduate from the University of Minnesota medical school and is now intern at the General Hospital in Minneapolis.

Dr. and Mrs. R. L. Burns of Two Harbors recently returned from a trip to Appleton, Wis., where they attended the golden wedding anniversary of Dr. Burns' parents.

Dr. G. V. Lynch has resigned his fellowship in surgery in the Mayo Foundation and has gone to Oshkosh, Wisconsin, where he will engage in the practice of surgery.

Dr. Arthur Bremkin, who has been associated with the Pine River Hospital, Pine River, Minnesota, for the past twelve years, has located at Waubun for private practice.

Dr. J. H. Kauffman of Cary has purchased the practice of Dr. R. W. Huffman at Elgin. Dr. Huffman has left for California, where he and his family will make their future home.

At the recent meeting of the Minnesota Sanatorium Association in St. Paul, Dr. M. George Milan of Thief River Falls was elected first vice president of the organization.

Announcement has been received of the wedding of Dr. Wendell L. Downing of the LeMars Clinic, LeMars, Iowa, to Miss Marion Klenk, which occurred at Buffalo, June 22.

Dr. W. B. Cannon, professor of Physiology at Harvard Medical School, gave a Mayo Foundation lecture at the Mayo Clinic June 20. His subject was, "Effects of the emotions on the body."

Dr. Richard E. Anderson of the Union Clinic, Willmar, was married Saturday, June 24, at Chicago, to Miss Caroline M. Schwartz of that city. Dr. and Mrs. Anderson are now at home in Willmar.

Dr. C. A. Ryan is now physician in charge at the Buena Vista Sanatorium, Wabasha. Dr. Ryan is a graduate of McGill University Medical College and has had special training in tuberculosis work.

Mr. and Mrs. Charles R. Teas of St. Paul have announced the marriage of their daughter, Madeline Teas Wood, to Dr. Stanley Robert Maxeiner of Minneapolis, which took place Thursday, July 27.

Dr. Walter N. Lee of Madison, Minnesota, has returned from a three weeks' encampment with National Guard troops at Camp Phillip Shelley, Lake City, Minnesota. Dr. Lee is a captain in the medical corps.

Dr. G. R. Moloney of Belle Plaine left July 13 for a two months' trip to his birthplace in Ireland. This is Dr. Moloney's first return to his home after a period of fifty years spent in the United States.

Dr. L. B. Wilson, Dr. L. S. Rowntree, Dr. Wm. L. Benedict, Dr. George B. Eusterman and Dr. Kendall represented the faculty of the Mayo Foundation at the commencement exercises at the University of Minnesota.

Dr. A. W. Adson of Rochester presented papers before a special meeting of the Utah Medical Association in Salt Lake City in June. He also attended the Pacific Northwest Medical Association meeting at Spokane in July.

Dr. A. G. Beyer, who has been in New York the past three months specializing in the study of the treatment of the eye, ear, nose and throat, has returned to Red Wing to take up his work in the firm of Drs. Johnson and Beyer.

The marriage of Dr. Ellsworth Johnson of Windom and Miss Carolyn Clark of St. Cloud took place in St. Cloud June 10. Dr. and Mrs. Johnson are now at home in Win-

dom following a trip through the northern part of the state.

Dr. E. L. Strader, superintendent of the Mineral Springs Sanatorium, Cannon Falls, and Miss Blanche Lizee, also a member of the sanatorium staff, were married June 28. Dr. and Mrs. Strader will make their home at the sanatorium.

Chester E. Sturges of Buffalo, Minn., graduated with honors from the University of Iowa Medical School this spring. He will take his internship and act as assistant house physician in an Omaha hospital before entering private practice.

The marriage of Dr. Lawrence J. Leonard, Minneapolis, and Miss Vera May Buckholz took place in Minneapolis June 29. Dr. and Mrs. Leonard will be at home in Minneapolis after their return from a trip through Yellowstone National Park.

In honor of his services as a physician over a period of fifty years, Dr. Ira Bishop of Mapleton was given a reception at Lura Lake the latter part of June. Dr. Bishop has gradually given up his practice after a lifetime devoted to his profession.

The marriage of Miss Marion Brown of New Orleans, La., to Dr. Shirley C. Lyons of Lake Charles, La., who has been a fellow in the Mayo Clinic at Rochester the past year, was solemnized at the home of Dr. and Mrs. E. L. Sinclair of Rochester, June 30.

Dr. Robinson Bosworth of the advisory board of the Minnesota Public Health Association, discussed the need of a tuberculosis sanatorium in southern Minnesota at the annual meeting of the County Public Health Association in Mankato last month.

Dr. H. L. Lamb has disposed of his medical practice at Sauk Centre to Dr. E. H. Richter of Minneapolis, who has recently completed his internship at the University General Hospital in Minneapolis. Dr. Lamb has located at Little Falls, where he plans to devote his time to the treatment of the eye, ear and throat.

Three St. Cloud physicians, Drs. Fred H. Stangl, P. E. Stangl and Irwin E. Bowing, have opened an exclusive medical office building in that city on the corner of First Street and Seventh Avenue South. Dr. Bowing with Dr. Fred H. Stangl recently came from Chicago to join Dr. P. E. Stangl in his practice at St. Cloud.

Dr. T. J. Trutna, Silver Lake, is in Chicago to take up special study in *x*-ray work, infant feeding, and eye treatment. He is attending clinics at the Illinois Post Graduate School, also clinics at other schools located in Chicago. Dr. M. F. Guyman of Minneapolis has charge of Dr. Trutna's practice during his absence.

Dr. Elmer Harry Hansen of Minneapolis and Miss Mary Elizabeth O'Brien, daughter of Mrs. John T. O'Brien, Cloquet, were married at the home of the bride's mother, June 28. Dr. and Mrs. Hansen have returned from a camping trip through the northern part of the state and are now at home at the Curtis Hotel, Minneapolis.

Dr. William Dodge, accompanied by Mrs. Dodge and his son, Warren, is motoring through Yellowstone Park, Great Falls and Kalispell, Mont., to Spokane, down the Columbia River to Portland, Oregon. They will return by way of Seattle. Dr. W. A. Hanson of Minneapolis is taking charge of Dr. Dodge's practice during his absence.

Dr. H. M. Wheeler of Grand Forks and Miss Mae McCulloch, formerly city visiting nurse in Grand Forks, were married in Minneapolis July 3. For the past two years Mrs. Wheeler has been engaged in special public health work in Cleveland and Mount Vernon, Ohio. Dr. and Mrs. Wheeler are now at home in Grand Forks.

Dr. Frank Lynam of Duluth, who is doing relief work in Russia, reports that patients in Russian hospitals are in dire need of food. Dr. Lynam, as representative of the American relief administration in the Kharkov district, states that the situation has been somewhat relieved of late. Thirty-seven hospitals in the district have been outfitted.

Dr. H. E. Bowers of Lake City has purchased the practice of his brother, Dr. J. T. Bowers, in the firm of Drs. Bowers and Bowers of that city. Dr. W. J. Cochrane, who practiced in Lake City for 20 years, but who has been located the last year at Monticello, Iowa, has announced his intention of returning to Lake City, September 1, to be associated in practice with Dr. H. E. Bowers.

Dr. Bert G. Anderson, who has charge of oral diagnosis at the Earl Clinic, St. Paul, has left for Pekin, China, where he is to become instructor in the Pekin Union Medical College, conducted by the Rockefeller Foundation. Dr. Anderson, who besides his clinical work was assistant professor at the University of Minnesota medical school, will have the same work at the Chinese institution.

Appointment of Dr. D. L. Bristol of Harvard University to head the department of public health and preventive medicine, recently created at the University of Minnesota, has been approved by the University Board of Regents. Professor Bristol taught at the medical department of the State University from 1908 to 1912, and was medical director of the St. Paul Anti-Tuberculosis Dispensary from 1910 to 1912.

The Wright County Medical Society held its annual outing at Buffalo, Thursday, July 27, for the doctors and their families. A picnic dinner at the residence of Dr. John J. Catlin, secretary of the society, was followed by a short program to which Dr. E. Geist of Minneapolis was a contributor. In the afternoon the meeting adjourned to Lake Constance for fishing and a picnic supper. Dr. Miller of Minneapolis, who accompanied Dr. Geist, showed great proficiency in the art of fishing.

Dr. Egil Boeckmann of St. Paul has been appointed to the Board of Regents of the University of Minnesota and his resignation from the State Board of Health has been accepted. Dr. C. L. Scofield of Benson, formerly vice president of the State Board of Health, was chosen president and Dr. S. Marx White of Minneapolis was elected vice president of the Board at a recent meeting. The vacancy on the Board made by Dr. Boeckmann's resignation has not as yet been filled by Governor Preus.

A committee from the Carnegie Foundation for the Advancement of Teaching is making a survey of Dental Education. The members of the committee recently spent a day at Rochester visiting the Foundation Clinic, and affiliated hospitals. The committee is composed of Dr. W. J. Gies, Professor of Biological Chemistry, Columbia University; Dr. C. A. Nixon, member of the State Board of Dental Examiners, Indiana; Dr. A. M. Reynolds, member of the State Board of Dental Examiners, Pennsyl-

vania; and Dr. C. R. Turner, Dean of the School of Dentistry, University of Pennsylvania.

The following fellows received the degree of M.S. in Surgery from the University of Minnesota June 14: Dr. C. F. Andrews, Dr. S. Brock, Dr. Hoon, Dr. A. S. Jackson, Dr. Magoun, Dr. Edw. V. Mastin, Dr. Parham, Dr. K. Renshaw, Dr. J. W. Ross and Dr. Wiese. Fellows receiving the degree of M.S. in Medicine were Dr. W. C. Chaney and Dr. Buchanan. Fellows receiving the degree of M.S. in Urology were Dr. A. R. Knauf and Dr. Latchem. Dr. Mahle received the degree of M.S. in Pathology; Dr. Bozer, the degree of M.S. in Otolaryngology, and Dr. Geo. W. Busman, the degree of M.S. in Dermatology.

Miss Grace McDonald, daughter of Dr. James McDonald, professor of physiology at Creighton University and formerly a fellow in surgery at the Mayo Clinic, became the bride of Dr. Joseph E. Heard, resident surgeon at St. Mary's Hospital, Rochester, in Minneapolis, June 28. Miss McDonald, who is a resident of Watertown, New York, has been in Rochester the past two years, engaged in the radiological department of the Mayo Clinic. Dr. and Mrs. Heard took an automobile trip through Mississippi to Fort Smith, Arkansas, where Dr. Heard will be an associate surgeon of Dr. C. S. Holt in the Holt Clinic.

Dr. Egil Boeckmann of the Minnesota State Board of Health at a recent meeting of the Board of Regents pointed out that out of 250 pre-medics only about eight will be permitted to enter the medical school in the fall. He also declared that the medical course was depriving Minnesota and the Northwest of much-needed practitioners. Dr. Mayo, at the same meeting, suggested that the medical college go on double shift in order to handle additional students. Without a formal vote, the board instructed Dr. Boeckmann to make a survey of conditions relative to admissions to the medical school and to organization of the medical curriculum.

Work has begun on the new Twin City Shriners' Hospital for Crippled Children. It is to be located on the River Boulevard on the east side of the Mississippi river about a mile from the end of the Franklin Avenue bridge, Minneapolis. The building will be a one-story structure, except the Administration building, which will be three stories. There will be accommodations for fifty patients in the house and it is hoped to build up a large outpatient service. The Hospital will be affiliated with the University of Minnesota so as to make the cases there available for instruction purposes. Dr. Wallace H. Cole has been appointed chief surgeon.

The board of directors of St. Luke's Hospital of Duluth has perfected an organization of the attending physicians and surgeons. An advisory or executive medical board of seven, consisting of Drs. J. J. Eklund, S. H. Boyer, A. N. Collins, Robert Graham, D. E. Seashore, D. L. Tilderquist and F. M. Turnbull, has been appointed. The directors also have selected a staff of fifty members, with Dr. J. J. Eklund as chief, and have approved a list of twenty-five attending men. The staff met and perfected a permanent organization on July 7, with Dr. J. J. Eklund as chief, Dr. Robert Graham as vice-chief, and Dr. M. H. Tibbetts as secretary. Provisions were made for regular monthly meetings of the staff at the hospital.

NEW AND NON-OFFICIAL REMEDIES

During June the following articles have been accepted by the Council on Pharmacy and Chemistry for inclusion in New and Non-official Remedies:

BORCHARDT MALT EXTRACT CO.:
- Borchardt's Malt Cod Liver Oil and Phosphorus.

INTRA PRODUCTS CO.:
- Ven Sterile Solution Procaine 0.5 Per Cent.
- Ven Sterile Solution Procaine 2.0 Per Cent.
- Ven Sterile Solution Procaine 5.0 Per Cent.

LEDERLE ANTITOXIN LABORATORIES:
- Pituitary Extract—Lederle (Obstetrical).
- Pituitary Extract—Lederle (Surgical).

PARKE, DAVIS & CO.:
- Diphtheria Antitoxin piston syringe containers.
- Antitetanic Serum piston syringe containers.
- Antigonococcic Serum 12 c.c. bulbs.
- Antistreptococcic Serum 20 c.c. piston syringe container.
- Antistreptococcic Serum 50 c.c. piston syringe container.
- Anti-Anthrax Serum.
- Antimeningococcic Serum.
- Diphtheria Toxin—Antitoxin Mixture.
- Tuberculin B. F. (Bovine).
- Gonococcus Vaccine 1 c.c. bulbs.
- Gonococcus Vaccine 1 c.c. syringe.
- Gonococcus Vaccine 5 c.c. bulb.
- Gonococcus Vaccine 20 c. blub.
- Erysipelas and Prodigiosus Toxins (Coley) 1 c.c. bulb.
- Erysipelas and Prodigiosus Toxins (Coley) 15 c.c. bulb.

Pollen Diagnostics-Lederle.—Liquids obtained by extracting the dried pollen of plants with a liquid consisting of 67 per cent glycerin and 33 per cent saturated solution of sodium chlorid. Pollen diagnostics-Lederle are marketed in capillary tubes containing 0.01 c.c. of a liquid, representing 100 pollen units. Pollen diagnostic-Lederle are employed in the diagnosis of hay-fever (Pollenosis). (See New and Non-official Remedies, 1922, (p. 232.) The following preparations have been accepted:

Arizona Ash Diagnostic-Lederle.—Prepared from the pollen of Arizona ash *(Fraxinus toumeyi).*

Arizona Walnut Diagnostic-Lederle.—Prepared from the pollen of Arizona walnut *(Juglans major).*

Black Walnut Diagnostic-Lederle.—Prepared from the pollen of black walnut *(Juglans nigra).*

Careless Weed Diagnostic-Lederle.—Prepared from the pollen of careless weed *(Amaranthus palmeri).*

Cottonwood Diagnostic-Lederle.—Prepared from the pollen of cottonwood *(Populus macdougali).*

June Grass Diagnostic-Lederle.—Prepared from the pollen of June grass *(Poa pratensis).*

Ragweed Diagnostic-Lederle.—Prepared from the pollen of ragweed *(Ambrosia elatior).*

Red Top Diagnostic-Lederle.—Prepared from the pollen of red top *(Agrostis palustris).*

Sage Brush Diagnostic-Lederle.—Prepared from the pollen of sage brush *(Artemisia tridentata).*

Shad Scale Diagnostic-Lederle.—Prepared from the pollen of shad scale *(Atriplex canescens).*

Sheep Sorrel Diagnostic-Lederle.—Prepared from the pollen of sheep sorrel *(Rumex acetosella).*

Slender Ragweed Diagnostic-Lederle.—Prepared from the pollen of slender ragweed *(Franseria tenuifolia).*

Sweet Vernal Grass Diagnostic-Lederle.—Prepared from the pollen of sweet vernal grass *(Anthoxanthum odoratum).*

Timothy Diagnostic-Lederle.—Prepared from the pollen of timothy *(Phleum pratense).*

Lederle Antitoxin Laboratories, New York. (Jour. A. M. A., June 10, 1922, p. 1803.)

Neutral Acriflavine-Heyl.—The base of 3:6 diamino-10 methylchloracridine, containing about 1.5 per cent of sodium chloride as a stabilizer. The actions, uses and dosage of neutral acriflavine-Heyl are essentially the same as those of acriflavine (see Acriflavine and Proflavine, New and Non-official Remedies, 1922, p. 25). Neutral Acriflavine-Heyl is also supplied in the following forms:

Neutral Acriflavine-Heyl Tablets 0.1 gm.
Neutral Acriflavine-Heyl Throat Tablets.
Neutral Acriflavine-Heyl "Pro Injectione," 0.5 gm. vials.
Neutral Acriflavine-Heyl "Pro Injectione," 1.0 gm. vials.

National Aniline and Chemical Co., New York. (Jour. A. M. A., June 17, 1922, p. 1893.)

Luminal Tablets ¼ Grain.—Each tablet contains luminal, ¼ grain. For a discussion of the actions, uses and dosage of luminal, see New and Non-official Remedies, 1922, p. 60.

Ven Sterile Solution Procain 0.5 Per Cent.—Each ampule contains 1 c.c. of a 0.5 per cent solution of procain-N. N. R. (New and Non-official Remedies, 1922, p. 35.) Intra Products Co., Denver.

Ven Sterile Solution Procain 2 Per Cent.—Each ampule contains 2 c.c. of a 2 per cent solution of procain-N. N. R. (New and Non-official Remedies, 1922, p. 35.) Intra Products Co., Denver.

Ven Sterile Solution Procain 5 Per Cent.—Each ampule contains 5 c.c. of a 5 per cent solution of procain-N. N. R. (New and Non-official Remedies, 1922, p. 35.) Intra Products Co., Denver, Colo. (Jour. A. M. A., June 17, 1922, p. 1893.)

Diphtheria Antitoxin (Concentrated Antidiphtheric Serum Globulin)-P. D. & Co.—Marketed in piston syringe containers, containing, respectively, 1,000, 3,000, 5,000, 10,000, and 20,000 units. Parke, Davis & Co., Detroit.

Antitetanic Serum (See New and Non-official Remedies, 1922, p. 282).—Also marketed in piston syringe containers, containing, respectively, 3,000, 5,000, and 10,000 units. Parke, Davis & Co., Detroit.

Antigonococcic Serum (See New and Non-official Remedies, 1922, p. 285).—Also marketed in bulbs, containing 12 c.c. Parke, Davis & Co., Detroit.

Antistreptococcic Serum-P. D. & Co. (See New and Non-official Remedies, 1922, p. 289).—Also marketed in piston syringe containers, containing, respectively, 20 c.c. and 50 c.c. Parke, Davis & Co., Detroit. (Jour. A. M. A., June 17, 1922, p. 1893.)

PROPAGANDA FOR REFORM

Evans Cancer Cure.—Dr. R. D. Evans, of Brandon, Manitoba, sells a "positive cure for cancer." The price is "one hundred dollars in advance!" The victim who parts with $100.00 for this cruel and worthless fake is told to shave a patch about the size of a dollar on the crown of the head. The "cure" is applied to this spot. This is for the treatment of internal cancer. "For 'external cancer' the discovery is applied on the spot." From an analysis made in the A. M. A. Chemical Laboratory, it was evident that Evans Cancer Cure is essentially a mixture of 1 part of a fatty substance (such as lard) and 5 parts of dried ferrous sulphate. (Jour. A. M. A., June 3, 1922, p. 1739.)

More Misbranded Nostrums.—The following products have been the subject of prosecution by the federal authorities, charged with the enforcement of the Food and Drugs Act:

Beil's New Nerve Tablets (Beil Mfg. Co.), consisting essentially of aloin, zinc phosphid, nux vomica extractives, resin, a laxative plant drug, magnesium and iron salts.

Diemer's Prescription for Gonorrhea and Gleet (Dr. F. W. Diemer Medicine Co.), consisting of pills which contain Epsom salt, calcium sulphid, ferrous sulphate and oil of cubebs, and tablets for external use, containing boric acid, zinc sulphate and hydrastin.

Diemer's Dyspepsia Tablets (Dr. F. W. Diemer Medicine Co.), consisting chiefly of baking soda, a laxative drug and ipecac alkaloids.

Diemer's Hot Toddy (Dr. F. W. Diemer Medicine Co.), tablets containing milk sugar, baking soda, a laxative plant drug and small amounts of ginger and red pepper.

Salicylates "Natural" and "Synthetic."—The Wm. S. Merrell Company rehashed the definitely refuted claim that "synthetic" salicylic acid is inferior to the "natural" kind. The Merrell Company suggests that, to avoid the effects of synthetic salicylic acid, physicians should specify "natural" and "Merrell" in writing prescriptions for sodium salicylate or any of the other salicylates. About ten years ago, the Council on Pharmacy and Chemistry instituted a thorough investigation of the asserted superiority of natural salicylic acid and salicylates over the ordinary or synthetic kind. This investigation afforded conclusive proof that the claim—based on a mixture of mysticism, commercial exploitation, misinterpretation and tradition—is without foundation. Nevertheless, the Merrell Company attempts to induce the medical profession to perpetuate this exploded fallacy and to specify the Merrell product, which costs twenty-four times as much as the synthetic sodium salicylate of U. S. P. quality. (Jour. A. M. A., June 3, 1922, p. 1742.)

The Intravenous Use of Acacia.—It is now generally accepted that acacia has a limited and uncertain usefulness. The intravenous use of acacia is a recent therapeutic procedure and apparently sufficient time has not elapsed for the thorough appraisal of its use as a therapeutic remedy. Bearing in mind the accidents from the use of acacia that have been reported, the lack of agreement as to its beneficial effects, among surgeons who have tried it, the experimental evidence that has been reported as to its deleterious effects and the paucity of data indicating its clinical usefulness, conservative practitioners will still withhold their verdict. Moreover, the questions of intravenous therapy,

which are involved in any discussion on the use of acacia in shock, hemorrhage and allied conditions, are an important and serious complicating consideration. (Jour. A. M. A., June 17, 1922, p. 1897.)

Vita Zest Not Admitted to N. N. R.—The Council on Pharmacy and Chemistry reports that Vita Zest (Vita Zest Co., Inc., New York City) comes in the form of capsules and is stated to be composed of 83⅓ per cent. of "highly concentrated vitamin extracts (Fat Soluble A, Water Soluble B, and Water Soluble C)." The amount of material in each capsule is not declared nor is any information offered to show that the amount (or potency) of the three vitamins said to be contained in the vitamin extract is determined or controlled. Even if it were shown that the product contains appreciable amounts of vitamins, the claims advanced for it are such that most enthusiastic advocates of the administration of vitamin would scoff at them. The Council declared Vita Zest inadmissible to New and Non-official Remedies, because (1) its composition is indefinite; (2) it is exploited under unwarranted therapeutic claims and in a manner which tends to its indiscriminate use, and (3) because the name suggests its haphazard use as a general tonic. (Jour. A. M. A., June 17, 1922, p. 1912.)

Laxatives—Untoward Effects of Laxatives.—Lately a number of instances of cutaneous manifestations due to the use of phenolphthalein as a laxative drug have been brought to the attention of physicians, particularly by dermatologists. Now Underhill and Errico have demonstrated that when magnesium sulphate, sodium sulphate and potassium and sodium tartrate are administered experimentally in doses capable of producing diarrhea, a distinct concentration of the blood may take place. The fact that purgatives exert a definite influence, in the direction of concentrating the blood, indicates that care should be exercised in the administration of purgatives in disease conditions, especially in those conditions known to be responsible for concentrated blood. Blood concentrated to some extent, and yet not sufficiently concentrated to be dangerous in itself, may reach a dangerous concentration by the added influence of the purgative. (Jour. A. M. A., June 24, 1922, p. 1964.)

BOOK REVIEWS

BOOKS RECEIVED FOR REVIEW

THE WRITING OF MEDICAL PAPERS. Maud H. Mellish, Editor of Mayo Clinic Publications. 12 mo. of 157 pages. Philadelphia and London: W. B. Saunders Company. 1922. Cloth, $1.50.

THE PRACTICE OF MEDICINE. A. A. Stevens, M.D., Professor of Applied Therapeutics in the University of Pennsylvania, Professor of Therapeutics and Clinical Medicine in the Woman's Medical College of Pennsylvania. Octavo of 1106 pages. Philadelphia and London: W. B. Saunders Co. 1922. Cloth, $7.50.

BIRTH STATISTICS. Annual Report of Department of Commerce Bureau of the Census, 1920. Washington Government Printing Office. 1922. 35c.

APPLIED CHEMISTRY. Fredus N. Peters, Ph.D., Instructor in Chemistry in Central High School, Kansas City, Mo., for 23 years. 461 pages. Illus. St. Louis: C. V. Mosby Company. 1922. Cloth, $3.50.

SYMPTOMS OF VISCERAL DISEASE. Francis Marion Pottenger, A.M., M.D., LL.D., F.A.C.P. 357 pages. 86 text illustrations. 10 color plates. St. Louis: C. V. Mosby Company. 1922 2nd edition. Cloth, $5.50.

OPERATIVE SURGERY. J. Shelton Horsley, M. D. Cloth, 721 pages with 613 illustrations. C. V. Mosby Co., St. Louis, 1921.

Dr. Horsley's book is written primarily from the point of view of preservation of physiologic function. It is written in a style that holds the reader's attention throughout, giving the author's experiences with various operative measures in a clear and concise manner. Operative procedures, now in vogue, which he does not believe result in restoration of function, he vigorously condemns.

It will be impossible for the reviewer to cover such a comprehensive field so a brief sketch will merely be given.

The early chapters deal with the generalities of surgery, such as general technic, drainage, etc. The chapter on drainage can be summed up in the statement that, "drainage really depends on the reversal of circulation in the local lymphatics."

The author, in his chapter on blood vessel surgery, introduces a method in which he uses essentially the Carrel technic but differs in that he uses a hook shaped frame which he calls an "arterial staff" to which he attaches his stay sutures. Instead of the running stitch of Carrel he uses the cobbler's stitch. He says that the surgeon should complete the operation in fifteen minutes, but with such an elaborate technic the reviewer feels that it could only be possible in the hands of the originator.

To become famous all that is necessary is to modify someone's technic in plastic surgery, a field unnecessarily filled with names. There are sufficient methods described for the operator to choose for all his needs.

Horsley believes that Bassini's operation results in 95% cure of indirect hernias, also describing the operations of Ferguson and Andrews but stating that his results have not been as good with these two operations.

In the removal of gall-bladders he follows the technic of Judd, in which the cystic duct is doubly clamped and the gall-bladder dissected from below upward. The raw surfaces left by the removal are closed by suturing the tissues together.

He does not use the technic of removal of the appendix by purse string and inversion but that of simple ligation and cautery. His statement that "in the majority of cases in which the stump has been buried I have found either unusual adhesions or a lump in the bowel or else a diverticulum," is questionable and will undoubtedly provoke a great deal of criticism.

The book is well illustrated and the illustrations are admirably drawn.

As a whole the book reflects conservatism and common sense and it will take its place among the better works on operative surgery.

ARTHUR H. PEDERSEN, M. D.

THE PLACE OF VERSION IN OBSTETRICS. Irving W. Potter. Published by C. V. Mosby & Co. Price $5.00.

In view of the fact that the subject matter of this small

volume has appeared in the literature from time to time and has been commented on, both favorably and unfavorably, we shall endeavor to give a more detailed review of the book and to do so with an unbiased mind.

Let no one lose sight of the fact that Dr. Potter is a mighty clever obstetrician and that on the whole he is very likely getting comparatively good results with his methods of delivery, and while there are many fine points about his technic, it does not follow that we can endorse the method as a whole.

All forceps deliveries and all versions done for good and sufficient reasons might be more successful if the operator carried out some of Potter's preliminaries, i. e., thorough intestinal cleansing, catheterization, surgical cleansing of the field of operation, ironing out of the perineum, complete cervical dilatation, separation of membranes and rupture high up, grasping of both feet (even the German text books recommend that no time be wasted in looking for the second foot, but to bring down both feet may be a greater advantage than is generally realized) and lastly the elimination of all rough handling of the newborn child; also the partial Walcher position and complete anesthesia.

That he is clever and careful is evidenced by the fact that he claims never to have had a case of uterine rupture, and it is plain that he evidently gets fewer and less severe lacerations. He repeatedly cuts the cord before delivery and has never caused injury to the child by so doing, and in at least two cases of placenta previa he separated and delivered the placenta before delivering the living child.

There are several things we would criticise, or at least question. He always uses his left hand and in all his illustrations a left-sided position is given. We would like to see illustrations of an actual performance of a left-handed version in a right position.

Potter does not think that bags can bring about a dilatation in any way comparable to the natural process. Neither do we, but is it not a fair question to ask if he thinks that his manual dilatation does?

He does not lay much emphasis on the information afforded by the pelvimeter and states that "the operator should at all times have a perfect knowledge of the position of the child in utero before version *is attempted* and an exact knowledge of this can be obtained only by introducing the hand to the fundus and exploring the uterus and the fetal parts carefully. This impresses us as being rather radical. On another page he states "the hand is is now free in the uterine cavity, the position of the child is made out and its probable size estimated, the position of the cord ascertained and the diameters of the pelvis approximated." The first part of this can be done by external examination; Ahlfeld's method, Muller's maneuver, and the use of the pelvimeter with the use of an anesthetic ought to give us reliable information, except perhaps in a few border-line cases. He suggests that this information be obtained before version is attempted; may we suggest that he get it before version is even contemplated.

The baby's feet are delivered together in the anterior-posterior diameter of the outlet and from here on the exposed parts of the baby are rotated as follows:—a rotation of 90 degrees to the right so that the fetal pelvis presented with its sacrum posterior; then a rotation of 180 degrees to the left so that the back is delivered anteriorly; then again 90 degrees to the right so that the left arm comes under the symphysis; then again 180 degrees to the left so that the posterior arm comes under the symphysis; then again 90 degrees to the right so that the face is delivered over the perineum.

He claims for his method that it offers great advantages for the mother, the child and the obstetrician. May we not be in danger of placing too much emphasis on the last three words?

As to Potter's results: His first paper, which was never published, deals with 500 versions without a maternal death. Fine work! He had 57 stillbirths in all and from all causes, 11.4 per cent. On this total, two-thirds were due to prolapsed cord and presumably to the version itself, as no other reason is stated. He does not state whether the prolapsed cord was present before he undertook the version, whether it developed during the version or was present after the version was completed. He certainly encounters many prolapsed cords and we all know that breech presentation and version are prolific in producing them.

In his second paper he reports an additional 200 versions without a maternal death in a total of 515 deliveries. Instruments were necessary for the aftercoming head 10 times, or 5 per cent. There were 15 cases of prolapsed cords, or 7 per cent. There were 16 stillbirths, of which 50 per cent were due to prolapsed cords. Three perinei were repaired with two silkworm sutures each but they had all been forceps delivery of the aftercoming head, all in primiparæ, all had large babies and they were all alive. Good results! He does not mention the number of Cæsarean sections.

In the following year he had 1,113 deliveries, of which 920 were by version and 80 Cæsarean sections, or slightly over 7 per cent. Twice the instruments were necessary for the aftercoming head and five deaths were due to prolapsed cords, in a total of 41 stillbirths, or slightly over 12 per cent.

In his last report he had 1,130 deliveries, of which 938 were by version and 100 by Cæsarean section, or about 9 per cent, and only twice were the forceps necessary for the aftercoming head.

While Potter's whole procedure looks and is radical, he does get good results, has few lacerations and no trouble with the head. But he does encounter a large number of prolapsed cords and they produce a large share of his stillbirths. He denies his patients everything that is understood by the test of labor and he performs a large and an increasing number of Cæsarean sections because of it. A man who personally delivers 1,130 women in one year must shorten the hours of labor.

ALBERT C. SCHULZE, M. D.